The New Brunswick
Electric Power Commission

Environmental Radiation Monitoring Data for Point Lepreau Generating Station January 1, 1991 to December 31, 1991

Health Physics Department

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Environmental Radiation Monitoring Data for Point Lepreau Generating Station January 1, 1991 to December 31, 1991

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EXECUTIVE SUMMARY

This report, issued annually, is a compilation of the 1991 Environmental Radiation Monitoring Program data collected around the Point Lepreau Generating Station (PLGS) and at reference locations remote from PLGS.

In 1991 about 1700 analyses were made on 1200 samples to monitor environmental radiation around Point Lepreau and across the province in general. Samples include: air particulates and air iodines, water vapour, carbon dioxide in air, sea water, well water, milk, beach sediments, clams, fish, lobster, dulse, crabs, periwinkles, scallops, sea plants, lichen and other sample types. Other environmental measurements include thermoluminescence dosimetry (TLD) and beach surveys using gamma survey meters.

The analyses indicate that radionuclide emissions from PLGS in 1991, as in previous years, continue to be well below 1% of the regulatory limits. The only assessable radiation dose from PLGS on the local population to the present time, is that from tritiated water vapour in air.

The calculated radiation dose from all emissions in the air pathway, to the most exposed hypothetical individual, is less than about 0.8 microsievert per annum at the exclusion zone boundary at 1 km from the station. Natural radiation in the area contributes more than 2000 times this dose. An insignificant additional dose contribution of less than about 0.1 microsievert per annum from Point Lepreau emissions into the seawater pathway is calculated to occur through the consumption of large quantities of seafood (calculated, since radioactivity from PLGS in seafood is consistently below limits of detection). All seafood contains relatively high concentrations of readily detected natural radioactivity (for example K-40) giving about two thousand times higher dose (about 0.16 millisievert) to the human body. However, this natural dose is also unavoidable as potassium is an essential element for life.

Population dose, which is the summation of all calculated doses over the entire population of this region within a 60 km radius from all emissions from PLGS, is about 0.6 person-millisievert in the seafood pathway and about 3.9 person-millisieverts in the airborne pathway for a population total of about 4.5 person-millisieverts. This should be compared with the population dose of about 320 000 person-millisieverts that this same group receives from natural background radiation alone and an additional 80 000 person-millisieverts received from radiation used in medical treatments.

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1.0 INTRODUCTION

The Environmental Radiation Monitoring Program for PLGS fulfils several objectives. These are:

1. To define the background levels of radiation in the area, whether naturally occurring, from weapons testing fallout, or from other sources not related to PLGS (e.g., the accident at Chernobyl).

2. To provide an early indication of the appearance of any radioactive material in the environment caused by the operation of PLGS and to verify that all significant pathways through the environment are identified.

3. To verify the adequacy and proper functioning of effluent controls and monitoring systems.

4. To provide an estimate of actual radiation exposure to the surrounding population from the operation of PLGS.

5. To provide assurance to the Atomic Energy Control Board (AECB - the regulating body for nuclear facilities), and to the general public that the station's environmental impact is comprehensively defined and is within anticipated limits.

Since 1976, the environmental radiation monitoring program has analyzed environmental samples to define background radiation, whether natural or from bomb tests, prior to the operation of PLGS in 1982. The analytical program detected and monitored radionuclide fallout in New Brunswick after a Chinese bomb test in 1980 and fallout from the reactor accident at Chernobyl in the USSR in April of 1986.

The radiation monitoring program is reviewed at least annually. This ensures that the samples collected, their frequency of collection, and the analytical techniques are appropriate to achieve the objectives of the program.

The capability of the radiation monitoring laboratory is continuously assessed through participation of the laboratory in a Quality Assurance analysis program administered by the U.S. Environmental Protection Agency (EPA) in Nevada. The EPA provides samples for blind analysis as described in Section 5.

The data contained in this report were collected from January 1, to December 31, 1991. During this time, the major sample types analyzed and their frequency of collection were as indicated in Table 1.01. As emissions from PLGS have been at less than 1% of the

Derived Emission Limits (DELs) since start-up, the frequency of collection is at Level 1, as shown in column 2 (<1% DEL) of this table.

TABLE 1.01

SCHEDULE OF SAMPLE COLLECTION AND ANALYSIS

SAMPLE TYPE OR SURVEY	LEVEL 1 FREQUENCY <1% DEL (1)	LEVEL 2 FREQUENCY 1-10% DEL	LEVEL 3 FREQUENCY >10% DEL
Air Particulate (2)	Monthly	Weekly	Weekly
Air Iodine (2)	Monthly	Weekly	Weekly
Air Tritium (2) and Carbon-14 (2)	Monthly	Weekly	Weekly
TLD (2)	Quarterly	Monthly	Monthly
Sediment	Quarterly	Monthly	Monthly
Beach Survey	Quarterly	Monthly	Weekly
Ground Water (Well, Surface)	Semi-annually	Quarterly	Monthly
Sea Water	Quarterly	Monthly	Monthly
Milk	Quarterly (3) Monthly (4)	Monthly	Monthly
Seafood (Clams Scallops, Dulse Crabs, Lobster Fish, Periwinkles)	Semi-annually	Monthly	Weekly
	As available		

(1) DEL means Derived Emission Limit.
(2) Integrated sample.
(3) From selected dairy herds in southern N.B.
(4) Commercial dairy milk sample.

All radionuclide analyses (approximately 1700 measurements on about 1200 samples) were carried out in the Health Physics Environmental Laboratory at 420 York Street, Fredericton, N.B.

In 1991, the only environmental samples which contained detectable radionuclides emitted from PLGS were:

1. Airborne water vapour samples and well waters containing tritium.

2. Air samples containing carbon-14.

3. Parshall flume and borehole waters from the Solid Radioactive Waste Management Facility (SRWMF), and the Parshall flume at the Dry Storage Facility (DFS), on the PLGS site, both of which contain tritium.

4. Lagoon waters from the PLGS site, containing tritium.

5. Seawater samples containing tritium.

6. Two seaweed samples containing iodine-131.

Outside the 1 km boundary, the activity of tritium in air as measured by airborne water vapour samples ranges from the natural tritium content of air of less than about 0.02 Bq/m^3 (i.e., less than the lower limit of detection by the method used) up to about 2 Bq/m^3 of air.

The Point Lepreau Generating Station was declared in Commercial Operation on January 31, 1983. The Gross Capacity Factors, indicating the level of operation over the last nine years, are tabulated below:

TABLE 1.02

PLGS PRODUCTION PERFORMANCE

	1983 %	1984 %	1985 %	1986 %	1987 %	1988 %	1989 %	1990 %	1991 %
Gross Capacity Factor	85.7	89.7	97.4	94.0	91.8	95.7	94.8	95.9	97.7

In 1991, as in all previous years, despite record high operational achievement at Point Lepreau GS, radionuclide emissions have remained well below target levels of 1% of the combined DELs in each emission pathway.

The numbers of environmental samples processed in each category over the last nine years are as shown in the following table:

TABLE 1.03

SAMPLE INFORMATION

Sample Type	Number of Samples Analyzed each year								
	1983	1984	1985	1986	1987	1988	1989	1990	1991
Air C-14	11	13	28	24	26	24	34	39	36
Air Iodine	363	208	208	208	206	174	96	104	96
Air Particulate	363	208	207	208	206	174	96	104	96
Air Tritium	94	101	104	104	104	92	96	104	96
Bore Hole	30	24	18	12	12	12	12	12	39
Clams	7	12	13	11	13	11	11	10	10
Crabs	–	1	2	1	3	3	2	1	3
Dulse	7	7	9	8	7	7	3	3	4
Fish	14	16	13	14	18	12	9	12	7
Lobster	5	7	8	7	9	9	7	8	7
Lagoon Sludge	2	–	–	11	–	–	–	–	–
Lagoon Water	2	22	33	38	37	36	35	35	34
Milk	20	19	20	28	17	19	20	17	20
Periwinkles	–	3	4	5	4	–	7	10	11
Parshall Flume	44	47	67	57	52	51	51	51	74
Quality Assur.	21	24	30	33	33	33	19	19	20
Scallops	3	7	8	6	2	3	6	2	3
Sediment	40	41	41	45	42	40	40	40	40
Soil	–	–	4	–	–	–	–	–	–
Sea Plant	–	4	8	13	15	11	10	12	16
Sea Water	17	18	17	18	19	18	18	16	16
Vegetation	13	13	13	33	13	14	14	4	15
Well Water	18	18	18	20	20	22	20	18	24
Miscellaneous	34	120	155	186	213	231	204	230	228
TLD	115	120	119	131	143	146	150	163	282
Beach Surveys	40	40	40	40	40	40	40	40	40

The miscellaneous samples include those which do not readily fit into any of the above categories or are not routinely collected. These include vegetation other than lichen or moss, berries, swamp water, rainwater, pond water and numerous in-station samples relating to the operation of PLGS. A sample of hardwood ash analyzed this year yielded some interesting results. Wood ash, like lichen, can contain unusually high levels of cesium-137 and strontium-90 (up to about 500 Bq/kg of wood ash) from bomb tests conducted in the 50s and 60s. As a consequence, these radionuclides will appear in landfill sites where wood ash is discarded without consideration of its contained, non-natural radioactivity. These radionuclides are also likely to be detected in foods grown where wood ash is used as fertilizer, and it is important that their presence not be confused with the operation of any nuclear power facility.

Other programs in place to monitor environmental samples from the Point Lepreau area are conducted by:

1. The Department of Health in New Brunswick.

2. The Bedford Institute of Oceanography, in Dartmouth, Nova Scotia.

3. The Federal Department of Health and Welfare in Ottawa.

Analytical results reported by the various agencies are generally comparable.

2.0 SAMPLE LOCATIONS

The major sample locations are shown in Figures 2.1 to 2.6. Each "Indicator" station has a three or four-character identification code (e.g., F01, I00A). An indicator station is one within the possible influence of PLGS emissions. "Reference" locations, chosen to lie outside the influence of PLGS operations, are identified by the letter R at the end of the location code (e.g., A01R).

Sampling locations for mobile seafood species (lobster, fish, etc.) caught in the Point Lepreau area are specified as accurately as reasonably possible. The location of capture, however, may bear little relationship to where the animal has been, except for the "Jonah" crabs which are caught near the PLGS cooling water outflow. With the exception of Reference location samples, all seafood samples analyzed are either purchased from local fishermen who made their catch in the Point Lepreau area or are collected by laboratory staff. Reference samples are purchased from fishermen or suppliers who fish outside of the Bay of Fundy region, for example from Chaleur Bay or the Northumberland Strait.

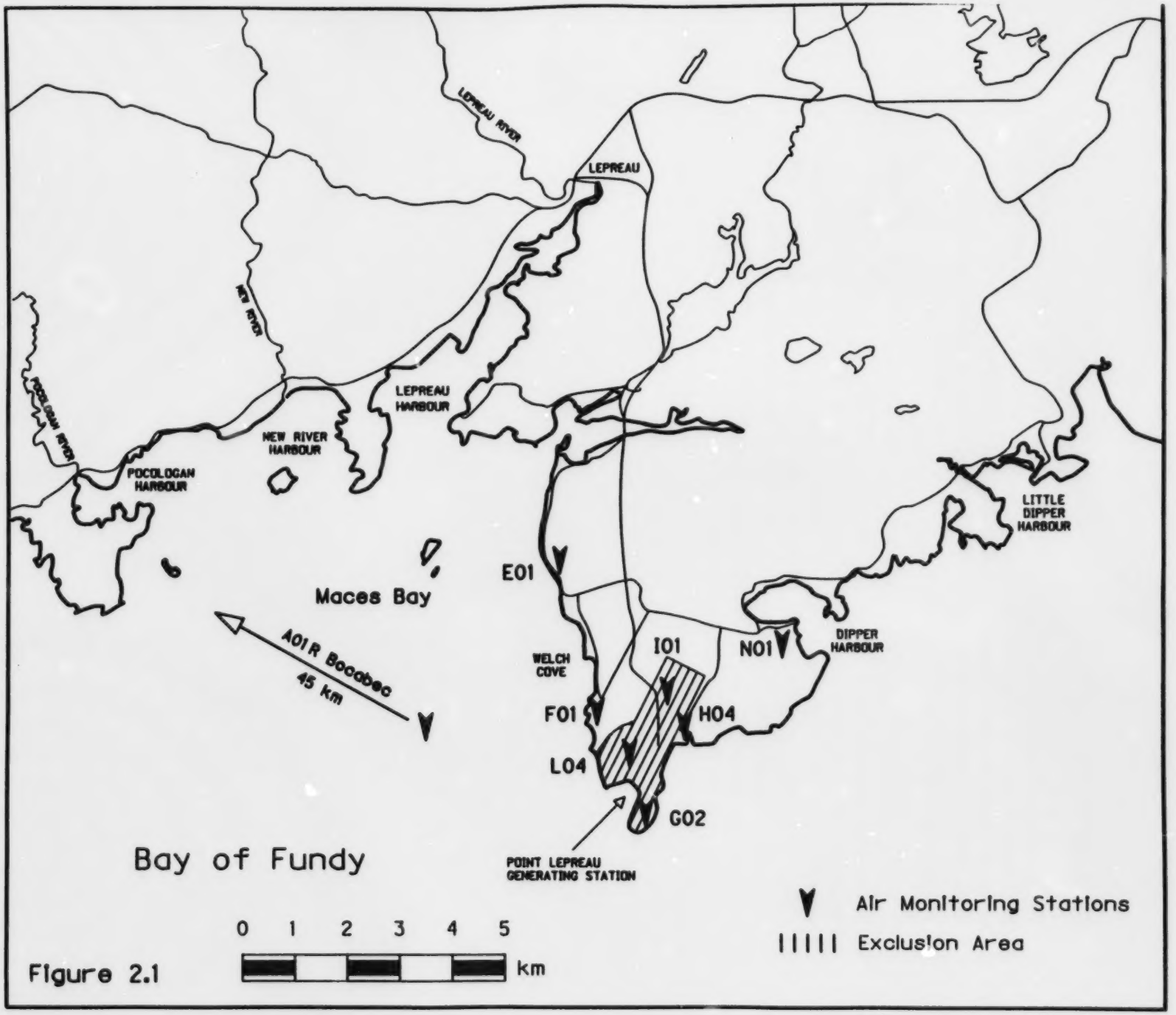
LEPREAU RIVER
LEPREAU
NEW RIVER
POCOLOGAN RIVER
LEPREAU HARBOUR
NEW RIVER HARBOUR
POCOLOGAN HARBOUR
LITTLE DIPPER HARBOUR
E01
Maces Bay
A01R Bocabec
45 km
WELCH COVE
I01
N01
DIPPER HARBOUR
F01
H04
L04
G02
POINT LEPREAU GENERATING STATION
Bay of Fundy
Air Monitoring Stations
Exclusion Area
0 1 2 3 4 5
km

Figure 2.1

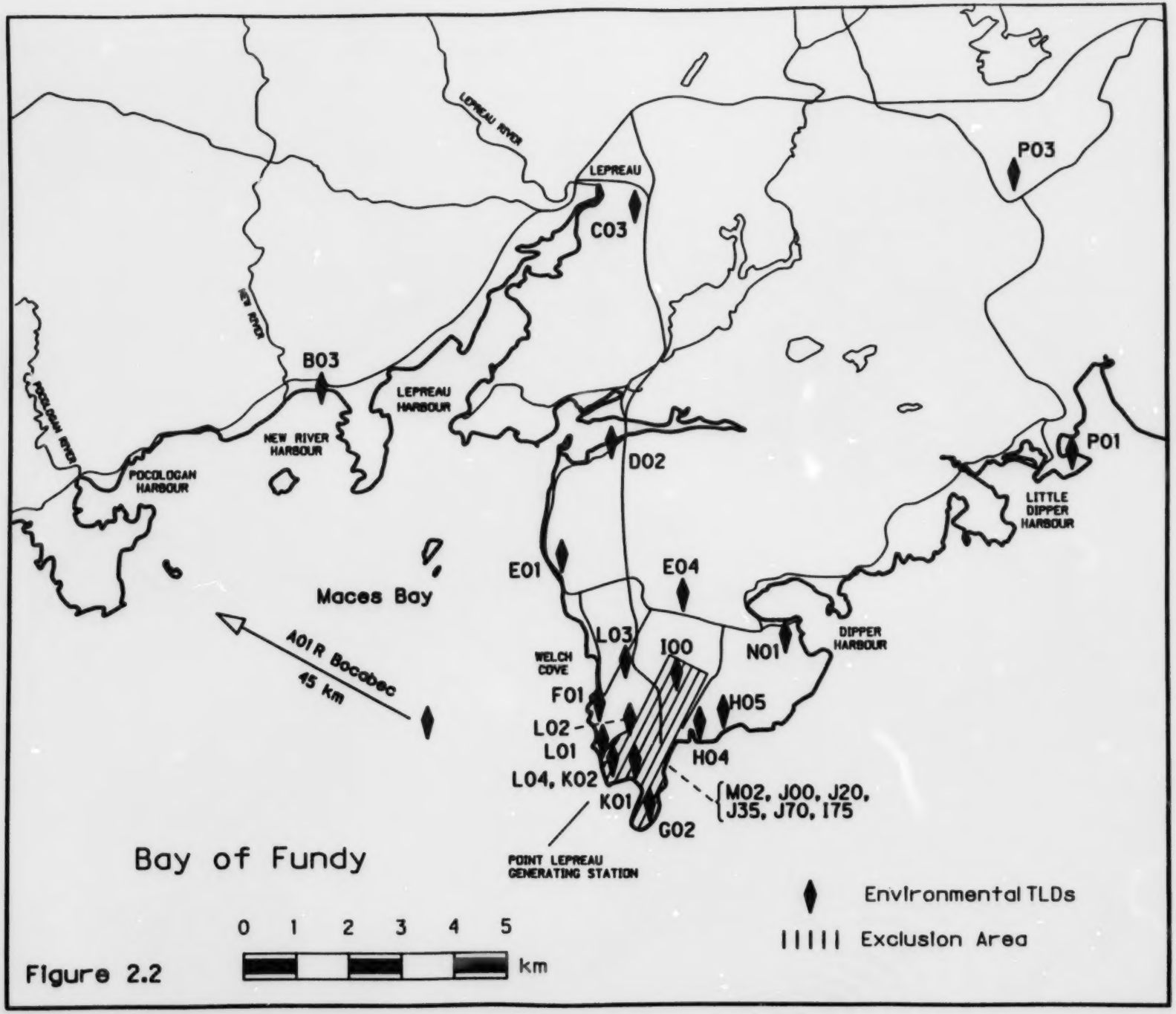
LEPREAU RIVER
LEPREAU
C03
P03
NEW RIVER
B03
LEPREAU HARBOUR
NEW RIVER HARBOUR
POCOLOGAN RIVER
POCOLOGAN HARBOUR
D02
P01
LITTLE DIPPER HARBOUR
E01
E04
Maces Bay
A01R Bocabec
45 km
L03
I00
N01
DIPPER HARBOUR
WELCH COVE
F01
H05
L02
L01
H04
L04, K02
K01
G02
M02, J00, J20, J35, J70, I75
POINT LEPREAU GENERATING STATION
Bay of Fundy
Environmental TLDs
Exclusion Area
0 1 2 3 4 5
km

Figure 2.2

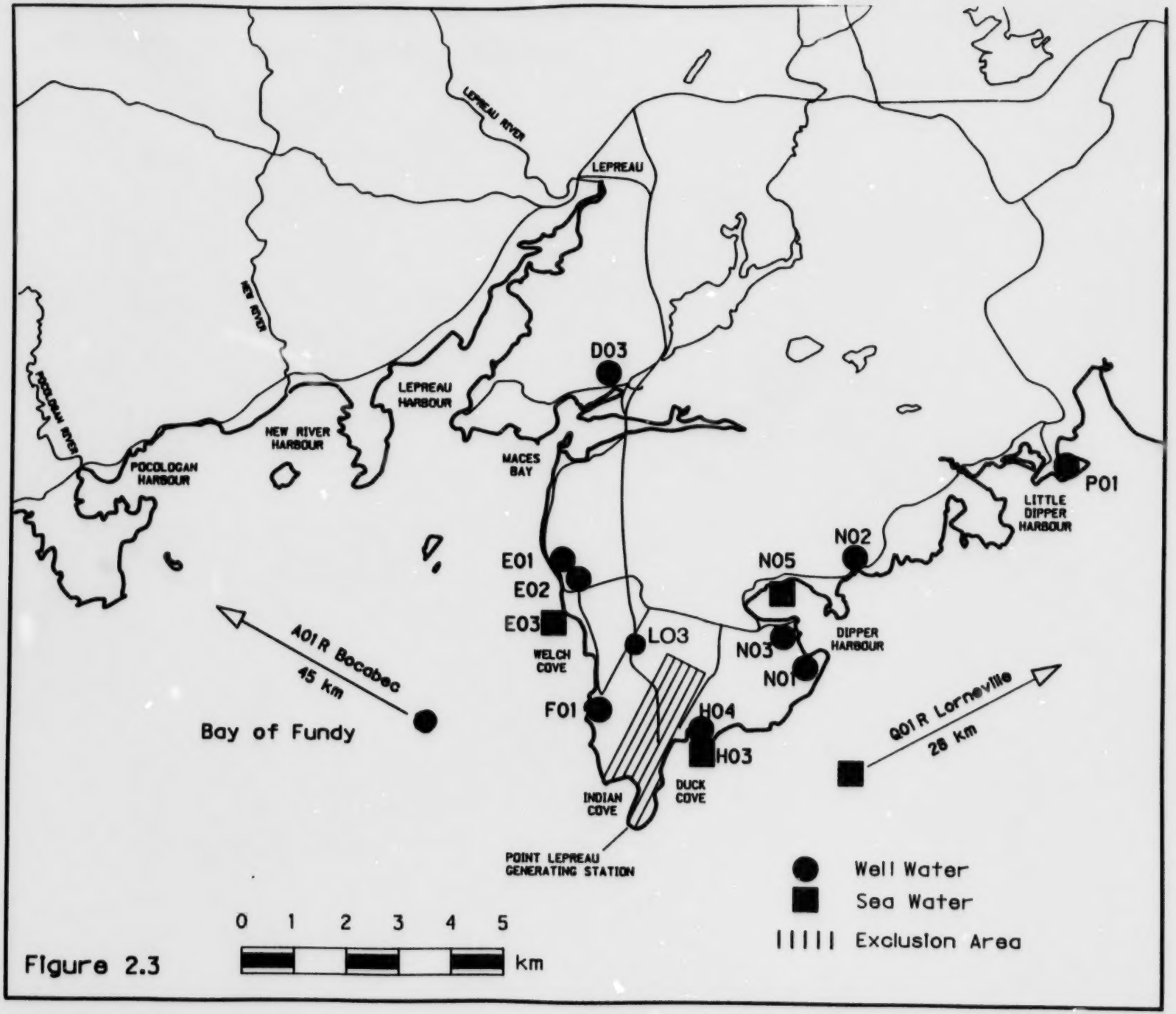
LEPREAU RIVER
LEPREAU
NEW RIVER
POCOLOGAN RIVER
D03
LEPREAU HARBOUR
NEW RIVER HARBOUR
POCOLOGAN HARBOUR
MACES BAY
P01
LITTLE DIPPER HARBOUR
N02
N05
E01
E02
E03
WELCH COVE
LO3
DIPPER HARBOUR
N03
N01
A01 R Bocabec
45 km
Bay of Fundy
F01
H04
H03
Q01 R Lorneville
26 km
INDIAN COVE
DUCK COVE
POINT LEPREAU GENERATING STATION
Well Water
Sea Water
Exclusion Area
0 1 2 3 4 5
km

Figure 2.3

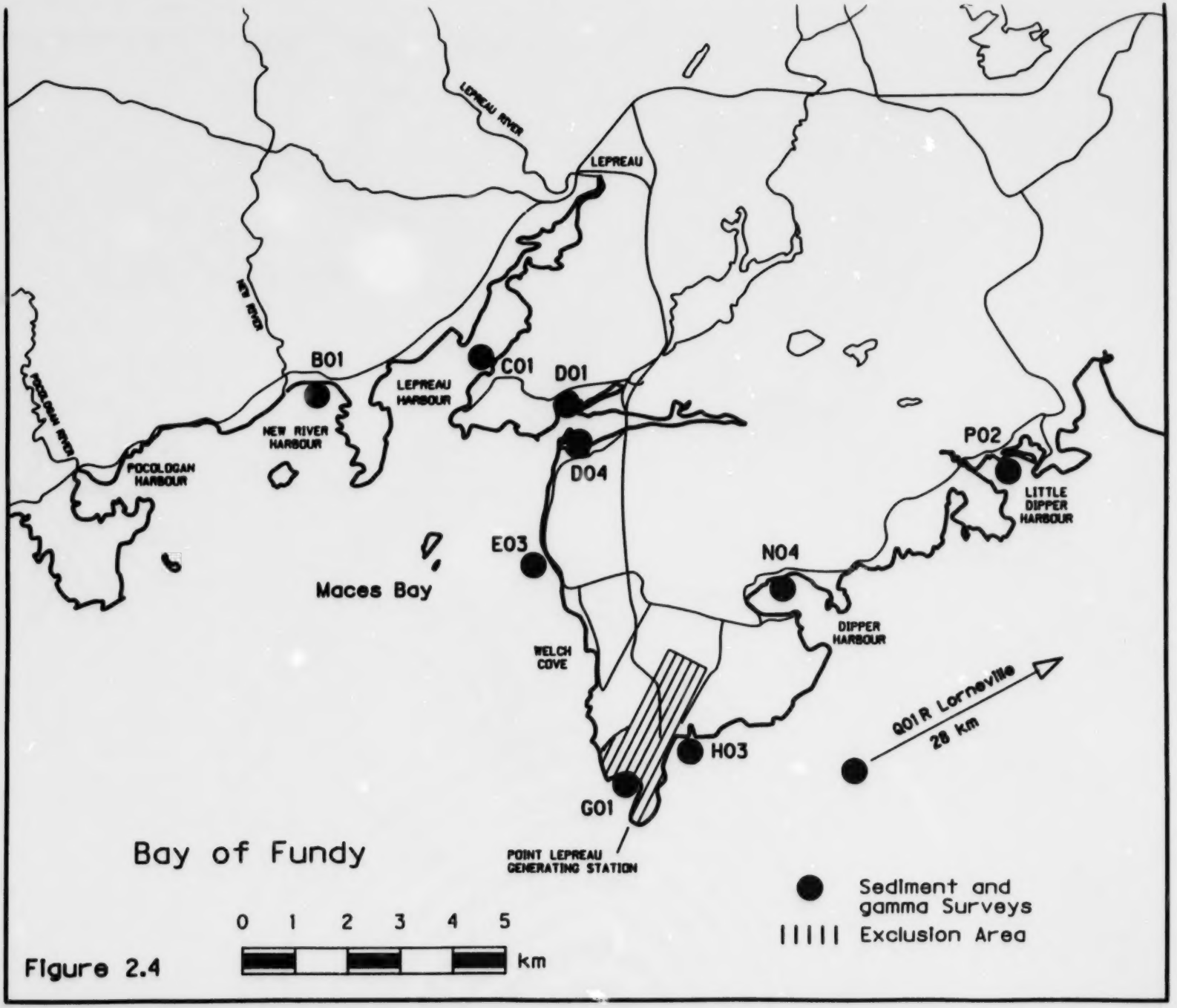
LEPREAU RIVER
LEPREAU
NEW RIVER
POCOLOGAN RIVER
B01
C01
D01
LEPREAU HARBOUR
NEW RIVER HARBOUR
POCOLOGAN HARBOUR
D04
P02
LITTLE DIPPER HARBOUR
E03
N04
Maces Bay
DIPPER HARBOUR
WELCH COVE
Q01R Lorneville
28 km
H03
G01
POINT LEPREAU GENERATING STATION
Bay of Fundy
Sediment and gamma Surveys
Exclusion Area
0 1 2 3 4 5
km

Figure 2.4

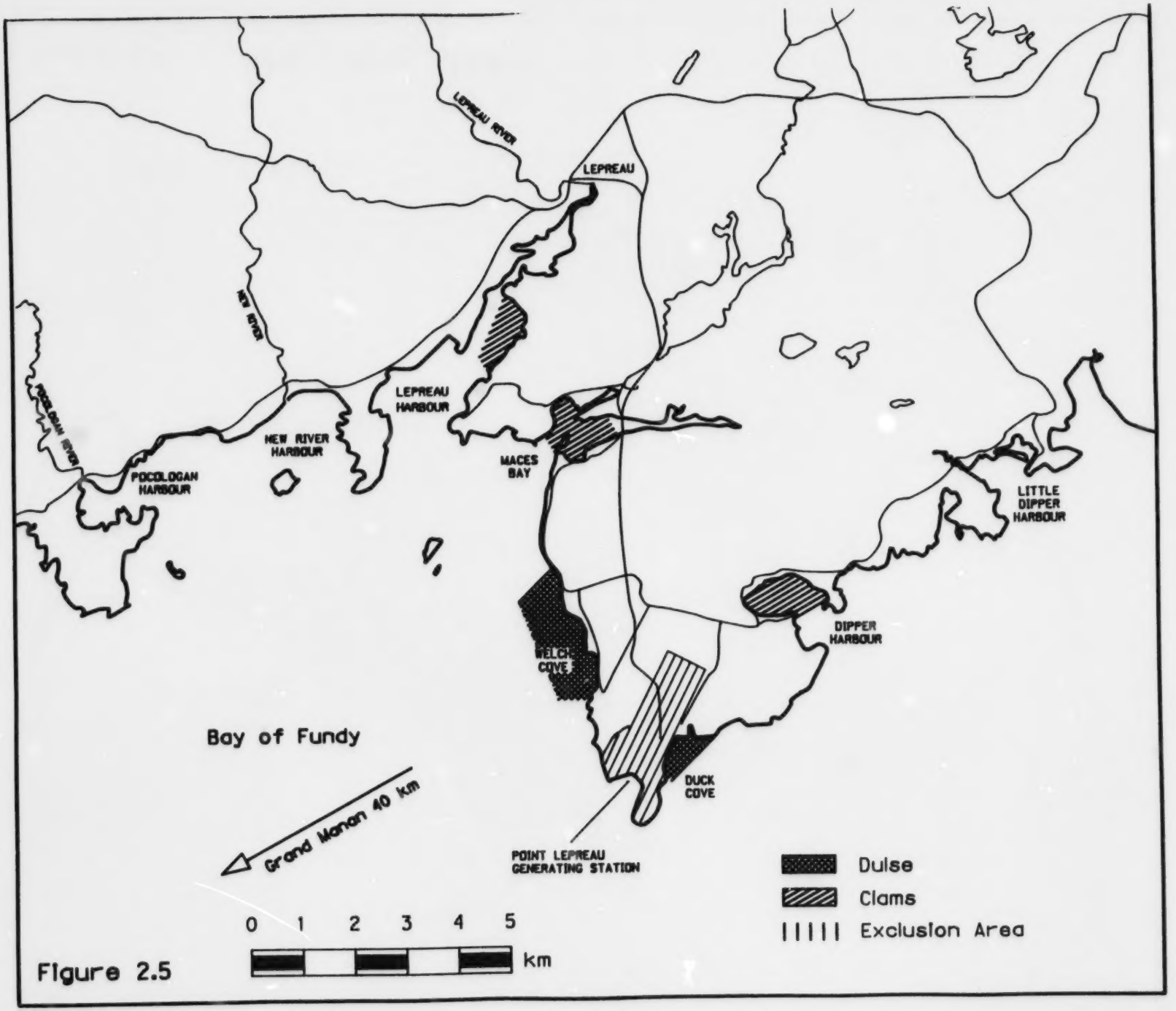
LEPREAU RIVER
LEPREAU
NEW RIVER
POCOLOGAN RIVER
LEPREAU HARBOUR
NEW RIVER HARBOUR
POCOLOGAN HARBOUR
MACES BAY
LITTLE DIPPER HARBOUR
DIPPER HARBOUR
WELCH COVE
DUCK COVE
Bay of Fundy
Grand Manan 40 km
POINT LEPREAU GENERATING STATION
Dulse
Clams
Exclusion Area
0 1 2 3 4 5
km

Figure 2.5

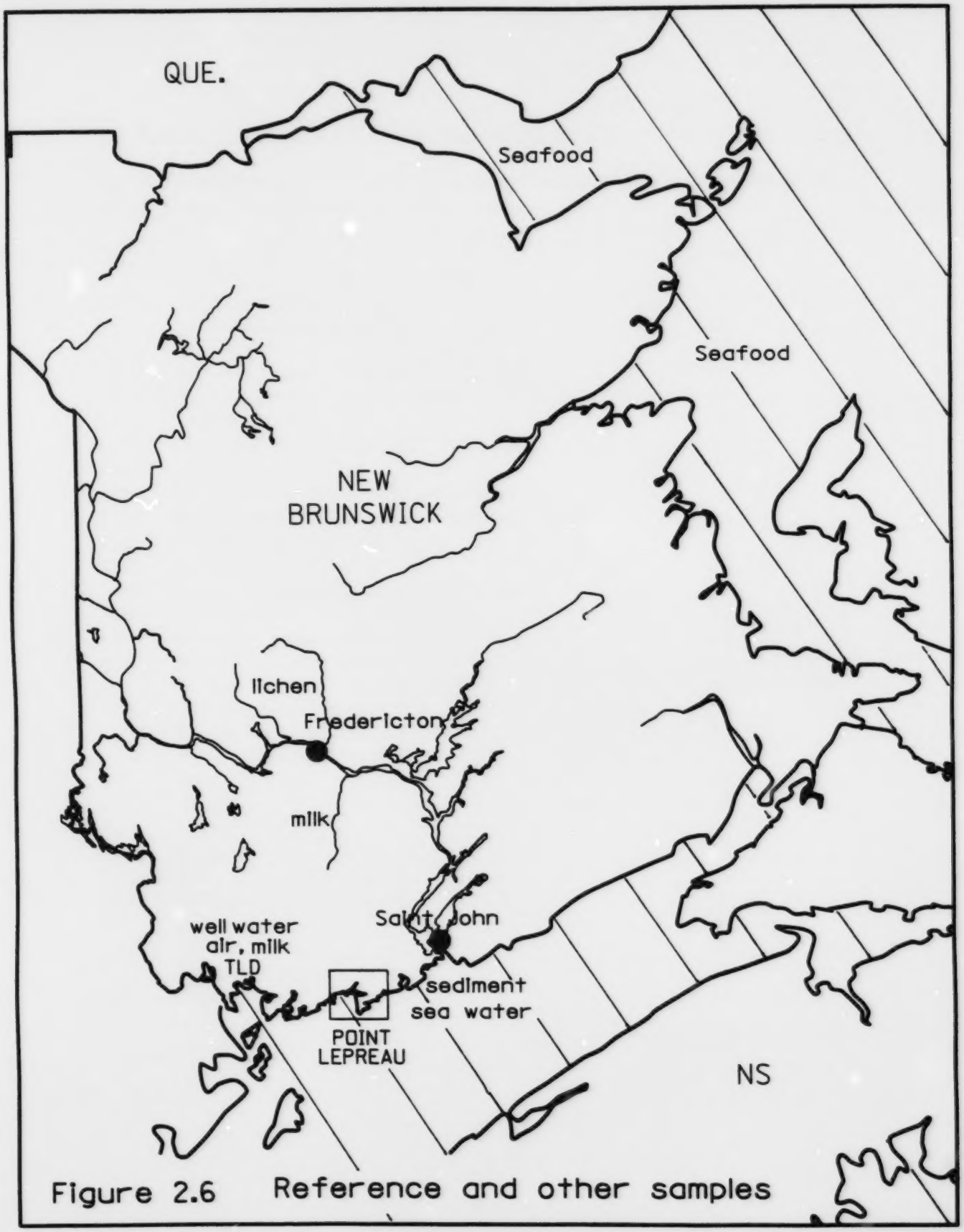

Figure 2.6 Reference and other samples

3.0 SUMMARY TABLES OF ENVIRONMENTAL DATA

The following tables provide a summary of the environmental data collected during the period January 1, to December 31, 1991.

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3.16	Clams.	58
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3.18	Dulse.	62
3.19	Fish.	64
3.20	Lobster.	66
3.21	Periwinkles.	68
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Most tables contain the following data:

Column 1 - Shows the type of analysis or nuclide and, in parentheses, the total number of samples analyzed.

Column 2 - Shows the mean of the Critical Levels (CLs) for all samples and, in parentheses, the range of the CLs. Any measurement greater than the CL is considered detected at the 99% confidence level (an explanation of the statistical protocol is given in Section 8).

Column 3 - Shows the mean of the detected values (i.e., values exceeding the CL) for all indicator stations, followed in parentheses by the ratio (F) of the number of detected values to the total number of indicator samples. Values less than or equal to the CL are not included in the mean. The second line of the column indicates the range of detected values for the indicator stations.

Column 4 - Shows the location code for the indicator station with the largest mean value. Refer to the maps of Section 2 for sample locations.

Column 5 - Shows the mean of detected values for the indicator station with the largest value, followed in parentheses by the ratio (F) of the number of detected values to the total number of samples for this indicator station. The second line of this column contains the range of detected values for this location.

Column 6 - Shows the mean of detected values at the Reference location(s), followed in parentheses by the ratio (F), of detected values to the total number of samples at this location. The second line of this column contains the range of detected values for the Reference location(s).

SUMMARY TABLES OF DATA

92-03-04

TABLE 3.01
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Airborne Particulate, Filter Bq/m3

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Mean (F) (Range)	Reference Station Mean (F) (Range)
ALPHA (96)	1.2E-005 (2.0E-006 - 7.0E-004)	2.5E-005 (84/84) (6.6E-006 - 7.3E-005)	E01	3.2E-005 (12/12) (1.6E-005 - 6.5E-005)	3.3E-005 (11/12) (1.9E-005 - 6.5E-005)
BETA (96)	3.4E-005 (6.0E-006 - 2.0E-003)	3.0E-004 (84/84) (3.8E-005 - 7.3E-004)	E01	4.0E-004 (12/12) (2.6E-004 - 7.3E-004)	3.9E-004 (11/12) (2.0E-004 - 6.9E-004)
Ce-144 (96)	3.9E-004 (6.5E-005 - 2.3E-002)	*		*	*
Ce-141 (96)	1.5E-004 (2.3E-005 - 9.6E-003)	*		*	*
Cr-51 (96)	1.1E-003 (1.4E-004 - 6.7E-002)	*		*	*
I-131 (96)	5.8E-004 (5.3E-005 - 4.6E-002)	*		*	*
Be-7 (96)	8.2E-004 (1.4E-004 - 4.4E-002)	2.0E-003 (78/84) (4.4E-004 - 4.1E-003)	E01	2.5E-003 (12/12) (1.7E-003 - 4.1E-003)	2.6E-003 (11/12) (1.2E-003 - 3.9E-003)
Ru-103 (96)	1.2E-004 (1.9E-005 - 7.9E-003)	*		*	*
Ba-140 (96)	1.3E-003 (1.0E-004 - 1.0E-001)	*		*	*
Cs-134 (96)	9.3E-005 (1.4E-005 - 5.5E-003)	*		*	*
Ru-106 (96)	1.1E-003 (1.2E-004 - 7.1E-002)	*		*	*
Cs-137 (96)	8.9E-005 (1.5E-005 - 5.0E-003)	*		*	*
Zr-95 (96)	1.5E-004 (2.6E-005 - 8.0E-003)	*		*	*
Nb-95 (96)	9.9E-005 (1.5E-005 - 5.8E-003)	*		*	*

TABLE 3.01 (Cont'd) 92-03-04
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Airborne Particulate, Filter Bq/m3

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Co-58 (96)	1.0E-004 (9.7E-006 - 6.5E-00?)	*		*	*
Mn-54 (96)	9.0E-005 (9.6E-006 - 5.3E-003)	*		*	*
Ag-110m (96)	1.4E-004 (1.6E-005 - 8.8E-003)	*		*	*
Ac-228 (96)	3.9E-004 (5.6E-005 - 2.3E-002)	*		*	*
Fe-59 (96)	2.7E-004 (2.4E-005 - 1.7E-002)	*		*	*
Zn-65 (96)	2.2E-004 (2.1E-005 - 1.3E-002)	*		*	*
Co-60 (96)	7.9E-005 (1.1E-005 - 3.3E-003)	*		*	*
K-40 (96)	1.7E-003 (0.0E+001 - 9.6E-002)	7.7E-004 (6/84) (5.5E-004 - 1.1E-003)	E01	1.1E-003 (1/12) (1.1E-003 - 1.1E-003)	1.7E-003 (1/12) (1.7E-003 - 1.7E-003)
La-140 (96)	3.2E-004 (3.9E-005 - 2.1E-002)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 3.02
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Airborne Iodine, Char. Cart. Bq/m3

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
I-131 (96)	2.0E-005 (1.6E-005 - 3.5E-005)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 3.03A
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

92-03-04

Airborne Tritium, Sieve Bq/m3

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Mean (F) (Range)	Reference Station Mean (F) (Range)
H-3 (96)	5.6E-002 (4.5E-003 - 3.1E-001)	6.4E-001 (75/84) (1.9E-002 - 3.7E+000)	101	1.4E+000 (12/12) (2.4E-001 - 3.7E+000)	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

92-03-04

TABLE 3.03B
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Airborne Tritium, Sieve Bq/m3

Collection Start Date +	A01R Bocabec ## 45	E01 Maces Bay 4.5	F01 Welch Cove 1.5	G02 Lepreau Lighthouse 1.0	H04 Information Centre 0.75	I01 SRWMF 1.0	L04 Construction Stores 0.6	N01 Dipper Harbour 3.8
91-01-04	< 3.0E-002	3.3E-002	5.9E-002	5.2E-002	2.6E-001	4.1E-001	1.2E-001	4.9E-002
91-02-16	< 2.1E-001	< 2.2E-002	1.9E-002	5.3E-001	1.4E-001	2.7E-001	2.1E-001	2.3E-002
91-03-16	< 4.6E-002	3.7E-002	1.6E-001	1.3E-001	5.0E-001	2.4E-001	7.6E-002	1.2E-001
91-04-15	< 2.1E-002	5.6E-002	9.2E-002	1.4E-001	8.5E-001	3.1E-001	4.2E-001	4.0E-001
91-05-14	< 1.2E-001	< 1.1E-001	1.5E-001	1.2E-001	9.0E-001	8.2E-001	2.2E-001	4.0E-001
91-06-11	< 1.2E-001	8.4E-002	2.7E-001	1.4E-001	2.2E+000	1.4E+000	3.8E-001	6.5E-001
91-07-09	< 2.0E-001	< 1.6E-001	2.2E-001	1.3E-001	3.4E+000	3.7E+000	5.6E-001	5.6E-001
91-08-01	< 2.3E-001	3.1E-001	< 1.5E-001	2.4E-00	2.7E+000	3.5E+000	5.7E-001	6.1E-001
91-09-07	< 1.4E-001	< 1.6E-001	1.3E-001	1.6E-001	2.7E+000	2.1E+000	3.8E-001	5.8E-001
91-10-05	< 9.4E-002	< 1.6E-001	2.7E-001	8.0E-001	1.9E+000	2.6E+000	1.1E+000	6.3E-001
91-11-03	< 3.3E-002	< 2.9E-002	7.3E-002	1.8E-001	9.8E-001	1.0E+000	3.1E-001	6.4E-002
91-12-09	< 2.7E-002	< 2.2E-002	< 1.8E-002	5.8E-001	5.9E-001	9.8E-001	1.6E-001	1.3E-001

+ : The sample collection periods are approximately four weeks in duration, so there are between 12 and 13 periods in the year. All sample stations are changed at the same time. The start date is the stop date for the previous sample.

: Approximate distance from Point Lepreau G.S. (km).

SRWMF - Solid Radioactive Waste Management Facility

TABLE 3.03C
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
76-01-01 to 91-12-31

Airborne Tritium, Sieve Bq/m3

Year (Samples Analysed)	Critical Level Mean (Range)	Indicator Stations Mean(F) (Range)	Reference Station Mean(F) (Range)
1976 to 1980 151	8.4E-2 (1.1E-3 to 3.3E-1)	2.4E-1 (33/119) (3.4E-3 to 3.0E-0)	2.2E-1 (6/32) (2.6E-2 to 3.4E-1)
1981 52	9.2E-2 (1.3E-2 to 2.4E-1)	1.9E-1 (3/46) (1.2E-1 to 3.3E-1)	7.6E-1 (2/6) (4.3E-1 to 1.1E+0)
1982 72	5.7E-2 (2.2E-2 to 5.2E-1)	2.2E-1 (18/62) (2.6E-2 to 2.0E+0)	4.9E-2 (2/10) (3.7E-2 to 6.1E-2)
1983 94	4.5E-2 (2.0E-2 to 1.7E-1)	2.4E-1 (52/82) (3.4E-2 to 1.3E+0)	1.7E-1 (4/12) (8.0E-2 to 2.7E-1)
1984 101	1.0E-1 (2.3E-2 to 2.7E-1)	7.1E-1 (73/88) (6.0E-2 to 5.6E+0)	1.4E-1 (2/13) (1.0E-1 to 1.8E-1)
1985 104	7.5E-2 (1.4E-2 to 2.8E-1)	5.7E-1 (77/91) (1.5E-2 to 3.3E+0)	8.0E-2 (1/13) (8.0E-2 to 8.0E-2)
1986 104	1.1E-1 (1.2E-2 to 5.1E-1)	1.3E+0 (81/91) (5.2E-2 to 9.1E+0)	1.3E-1 (1/13) (1.3E-1 to 1.3E-1)
1987 104	7.9E-2 (1.1E-2 to 4.7E-1)	1.0E+0 (76/91) (3.7E-2 to 6.4E+0)	1.0E-1 (1/13) (1.0E-1 to 1.0E-1)
1988 92	9.8E-2 (2.4E-2 to 3.1E-1)	1.3E+0 (75/80) (4.8E-2 to 1.1E+1)	4.8E-2 (1/12) (4.8E-2 to 4.8E-2)
1989 96	1.0E-1 (1.8E-2 to 5.2E-1)	1.2E+0 (69/84) (4.0E-2 to 5.3E+0)	* (0/12)
1990 104	7.2E-2 (7.6E-3 to 3.1E-1)	9.9E-1 (85/91) (3.8E-2 to 5.8E+0)	1.2E-1 (2/13) (8.6E-2 to 1.6E-1)
1991 96	5.6E-2 (4.5E-3 to 3.1E-1)	6.4E-1 (75/84) (1.9E-2 to 3.7E+0)	* (0/12)

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 3.04A
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Airborne C-14, Caustic Bubbler Bq/m3

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Mean (F) (Range)	Reference Station Mean (F) (Range)
C-14 (36)	1.8E-001 (8.2E-002 - 7.1E-001)	1.6E-001 (2/24) (1.3E-001 - 1.9E-001)	H04	1.9E-001 (1/12) (1.9E-001 - 1.9E-001)	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 3.048 92-03-04
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Airborne C-14, Caustic Bubbler Bq/m3

Collection Start Date +	G02 Lepreau Lighthouse	H04 Information Centre	X03R Fredericton Laboratory
91-01-04	< 1.2E-001	< 1.7E-001	< 2.0E-001
91-02-16	< 1.8E-001	< 1.5E-001	< 3.8E-001
91-03-16	< 2.2E-001	< 1.7E-001	< 5.0E-001
91-04-15	< 1.8E-001	1.9E-001	< 2.7E-001
91-05-14	< 1.0E-001	< 1.4E-001	< 2.0E-001
91-06-11	< 1.6E-001	< 1.2E-001	< 1.1E-001
91-07-09	< 8.2E-002	< 2.7E-001	< 1.2E-001
91-08-01	1.3E-001	< 8.2E-001	< 2.0E-001
91-09-07	< 2.5E-001	< 1.1E-001	< 2.1E-001
91-10-05	< 2.1E-001	< 1.0E-001	< 2.2E-001
91-11-03	< 1.8E-001	< 1.4E-001	< 2.3E-001
91-12-09	< 1.6E-001	< 2.0E-001	< 4.4E-001

+ : The sample collection periods are approximately four weeks in duration, so there are between 12 and 13 periods in the year. The two indicator stations are changed at the same time.

92-03-04

TABLE 3.05A
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Year
1991

TLD, Environmental uSv +- 10%

Location	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
A01R	170 +- 17	172 +- 17	197 +- 20	173 +- 17	710 +- 40
B03	189 +- 19	227 +- 23	199 +- 20	180 +- 18	800 +- 40
C03	169 +- 17	235 +- 24	210 +- 21	188 +- 19	800 +- 40
D02	180 +- 18	235 +- 24	211 +- 21	196 +- 20	820 +- 40
E01	170 +- 17	191 +- 19	202 +- 20	168 +- 17	730 +- 40
E04	158 +- 16	207 +- 21	171 +- 17	154 +- 15	690 +- 30
E05	167 +- 17	215 +- 22	178 +- 18	169 +- 17	730 +- 40
E05A	244 +- 24	261 +- 26	252 +- 25	246 +- 25	1000 +- 50
F01	139 +- 14	158 +- 16	152 +- 15	135 +- 14	580 +- 30
G02	170 +- 17	183 +- 18	174 +- 17	160 +- 16	690 +- 30
H04	162 +- 16	176 +- 18	157 +- 16	132 +- 13	630 +- 30
H05	145 +- 14	177 +- 18	154 +- 15	149 +- 15	630 +- 30
I00A	198 +- 20	253 +- 25	244 +- 24	222 +- 22	920 +- 50
I00B	244 +- 24	251 +- 25	240 +- 24	239 +- 24	970 +- 50
I00C	214 +- 21	271 +- 27	242 +- 24	241 +- 24	970 +- 50
I00D	245 +- 24	252 +- 25	233 +- 23	224 +- 22	950 +- 50
I00E	218 +- 22	247 +- 25	238 +- 24	210 +- 21	910 +- 50
I00F	212 +- 21	255 +- 26	231 +- 23	222 +- 22	920 +- 50
I00G	247 +- 25	256 +- 26	250 +- 25	217 +- 22	970 +- 50
I00H	225 +- 22	262 +- 26	244 +- 24	225 +- 22	960 +- 50
I00I	244 +- 24	260 +- 26	252 +- 25	230 +- 23	990 +- 50
I00J	222 +- 22	257 +- 26	237 +- 24	224 +- 22	940 +- 50
I00K	217 +- 22	263 +- 26	239 +- 24	226 +- 23	950 +- 50
I00L	212 +- 21	248 +- 25	249 +- 25	208 +- 21	920 +- 50
I03A	NA	NA	198 +- 20	185 +- 18	770 +- 30
I03B	NA	NA	208 +- 21	193 +- 19	800 +- 30
I03C	167 +- 17	195 +- 20	170 +- 17	180 +- 18	710 +- 40
I03D	NA	NA	192 +- 19	214 +- 21	810 +- 30
I03E	162 +- 16	166 +- 17	210 +- 21	206 +- 21	740 +- 40
I03F	157 +- 16	195 +- 20	183 +- 18	224 +- 22	760 +- 40
I03G	NA	NA	187 +- 19	224 +- 22	820 +- 30
I03H	NA	NA	213 +- 21	200 +- 20	830 +- 30
I03I	NA	NA	194 +- 19	193 +- 19	770 +- 30
I03J	124 +- 12	NA	204 +- 20	191 +- 19	690 +- 30
I03K	NA	207 +- 21	209 +- 21	179 +- 18	790 +- 30
I03L	130 +- 13	203 +- 20	187 +- 19	180 +- 18	700 +- 40
I75	201 +- 20	243 +- 24	194 +- 19	189 +- 19	830 +- 40
I86	NA	NA	189 +- 19	171 +- 17	720 +- 30
I87	NA	NA	183 +- 18	168 +- 17	700 +- 20
I88	NA	NA	211 +- 21	166 +- 17	750 +- 30
I89	NA	NA	182 +- 18	185 +- 18	730 +- 30
I90	146 +- 15	191 +- 19	163 +- 16	149 +- 15	650 +- 30
I91	181 +- 18	196 +- 20	178 +- 18	168 +- 17	720 +- 40

TABLE 3.05A (Cont'd) 92-03-04
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Year
1991

TLD, Environmental uSv +- 10%

Location	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
I92	169 +- 17	183 +- 18	176 +- 18	164 +- 16	690 +- 30
I93	176 +- 18	191 +- 19	170 +- 17	163 +- 16	700 +- 40
I94	186 +- 19	198 +- 20	197 +- 20	187 +- 19	770 +- 40
I95	169 +- 17	188 +- 19	172 +- 17	160 +- 16	690 +- 30
I96	143 +- 14	193 +- 19	168 +- 17	149 +- 15	650 +- 30
I97	174 +- 17	205 +- 20	190 +- 19	167 +- 17	740 +- 40
I98	174 +- 17	222 +- 22	206 +- 21	194 +- 19	800 +- 40
I99	184 +- 18	204 +- 20	187 +- 19	172 +- 17	750 +- 40
J00	201 +- 20	221 +- 22	200 +- 20	185 +- 18	810 +- 40
J20	217 +- 22	246 +- 25	201 +- 20	183 +- 18	850 +- 40
J35	171 +- 17	252 +- 25	215 +- 22	183 +- 18	820 +- 40
J70	326 +- 33	335 +- 34	286 +- 29	305 +- 30	1250 +- 60
K01	183 +- 18	222 +- 22	180 +- 18	189 +- 19	770 +- 40
K02	223 +- 22	255 +- 26	228 +- 23	213 +- 21	920 +- 50
L01	153 +- 15	208 +- 21	163 +- 16	179 +- 18	700 +- 40
L02	228 +- 23	259 +- 26	219 +- 22	214 +- 21	920 +- 50
L03	165 +- 16	194 +- 19	175 +- 18	163 +- 16	700 +- 30
L04	192 +- 19	201 +- 20	198 +- 20	180 +- 18	770 +- 40
M02	284 +- 28	298 +- 30	279 +- 28	268 +- 27	1130 +- 60
N01	179 +- 18	220 +- 22	197 +- 20	190 +- 19	790 +- 40
P01	126 +- 13	154 +- 15	130 +- 13	124 +- 12	530 +- 30
P03	155 +- 16	216 +- 22	207 +- 21	173 +- 17	750 +- 40

NA : Data not Available - Lost or destroyed TLD, or site not in use for this collection interval.

TABLE 3.05B
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses
1978 - 1991

TLD, Environmental uSv — Annual absorbed dose

Locn.	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
A01R	760	660	660	750	960	840	750	900	850	800	920	840	700	710
B03	960	840	740	670	840	820	780	890	880	870	920	850	730	800
C03	930	900	850	820	870	910	810	940	890	890	980	880	790	800
D02	730	880	810	790	860	890	880	920	920	890	990	910	800	820
E01	600	850	670	620	890	740	680	800	840	790	880	800	690	730
E04	690	940	800	730	850	710	710	790	740	760	800	760	620	690
E05	--	--	--	--	--	--	--	--	--	--	--	820	700	730
E05A	--	--	--	--	--	--	--	--	--	--	--	--	980	1000
F01	730	780	960	790	810	650	600	690	680	690	720	640	570	580
G02	760	880	780	690	850	720	690	770	760	800	790	700	650	690
H04	560	730	540	590	770	650	650	720	710	730	770	840	610	630
H05	750	760	670	640	760	720	680	760	760	740	740	670	610	630
I00A	--	--	850	780	970	980	930	1090	1020	1050	1140	1180	940	920
I00B	--	--	960	1040	990	970	970	1110	1080	1080	1150	1100	980	970
I00C	--	--	840	930	1010	960	1000	1110	1060	1060	1150	1070	940	970
I00D	--	--	800	920	960	970	950	1090	1070	1030	1120	1070	900	950
I00E	--	--	830	890	920	950	970	1030	1030	1020	1090	1020	920	910
I00F	--	--	830	930	900	[illegible]0	960	1070	1050	1010	1090	1020	920	920
I00G	--	--	840	960	940	910	910	1100	1030	1020	1130	1030	930	970
I00H	--	--	850	1000	1010	960	960	1100	1090	1040	1150	1060	980	960
I00I	--	--	780	970	920	950	910	1070	1020	1020	1080	1070	910	990
I00J	--	--	890	910	850	880	910	1030	1020	990	1080	1020	950	940
I00K	--	--	750	820	920	880	920	1030	940	1000	1090	1030	950	950
I00L	--	--	920	1070	900	960	920	1040	970	1010	1080	1030	930	920
I03A	--	--	--	--	--	--	--	--	--	--	--	--	--	770
I03B	--	--	--	--	--	--	--	--	--	--	--	--	--	800
I03C	--	--	--	--	--	--	--	--	--	--	--	--	530	710
I03D	--	--	--	--	--	--	--	--	--	--	--	--	--	810
I03E	--	--	--	--	--	--	--	--	--	--	--	--	550	740
I03F	--	--	--	--	--	--	--	--	--	--	--	--	600	760
I03G	--	--	--	--	--	--	--	--	--	--	--	--	--	820
I03H	--	--	--	--	--	--	--	--	--	--	--	--	--	830
I03I	--	--	--	--	--	--	--	--	--	--	--	--	--	770
I03J	--	--	--	--	--	--	--	--	--	--	--	--	300	690
I03K	--	--	--	--	--	--	--	--	--	--	--	--	490	790
I03L	--	--	--	--	--	--	--	--	--	--	--	--	--	700

TABLE 3.05B (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses
1978 - 1991

TLD, Environmental uSv — Annual absorbed dose

Locn.	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
I75	--	--	--	--	--	--	--	--	1140	940	980	920	830	830
I86	--	--	--	--	--	--	--	--	--	--	--	--	--	720
I87	--	--	--	--	--	--	--	--	--	--	--	--	--	700
I88	--	--	--	--	--	--	--	--	--	--	--	--	--	750
I89	--	--	--	--	--	--	--	--	--	--	--	--	--	730
I90	--	--	--	--	--	--	--	--	--	--	--	--	520	650
I91	--	--	--	--	--	--	--	--	--	--	--	--	600	720
I92	--	--	--	--	--	--	--	--	--	--	--	--	530	690
I93	--	--	--	--	--	--	--	--	--	--	--	--	560	700
I94	--	--	--	--	--	--	--	--	--	--	--	--	640	770
I95	--	--	--	--	--	--	--	--	--	--	--	--	560	690
I96	--	--	--	--	--	--	--	--	--	--	--	--	550	650
I97	--	--	--	--	--	--	--	--	--	--	--	--	610	740
I98	--	--	--	--	--	--	--	--	--	--	--	--	--	800
I99	--	--	--	--	--	--	--	--	--	--	--	--	--	750
J00	--	--	--	--	--	--	--	--	960	900	970	900	820	810
J20	--	--	--	--	--	--	--	--	1000	970	1020	960	870	850
J35	--	--	--	--	--	--	--	--	900	920	970	850	780	820
J70	--	--	--	--	--	--	--	--	1580	1410	1470	1400	1170	1250
K01	690	1090	830	790	900	850	820	940	930	930	960	910	780	770
K02	--	--	--	--	--	830	850	920	950	950	1060	1000	840	920
L01	710	880	790	680	830	780	750	850	810	810	870	800	740	700
L02	840	1000	870	930	990	920	910	1020	1070	980	1130	1040	920	920
L03	550	660	640	570	770	650	630	720	750	750	780	710	720	700
L04	--	--	--	--	--	--	--	--	--	--	970	860	770	770
M02	--	--	--	--	--	--	--	--	1180	1250	1330	1210	1120	1130
N01	780	1040	660	680	890	850	800	920	880	930	980	940	820	790
P01	560	690	550	490	660	610	580	670	680	670	710	630	570	530
P03	710	730	650	680	750	720	690	790	710	760	1020	890	760	750

-- : TLDs not used in these locations at this time.

92-03-04

TABLE 3.05C
Point Lepreau Generating Station
Dry Fuel Storage Drop Off Radiation Monitoring
Summary of Analyses for the Year
1991

TLD, Environmental uSv +- 10%

Location	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
A 5m	NA	NA	206 +- 21	248 +- 25	910 +- 30
A 10m	NA	NA	226 +- 23	240 +- 24	930 +- 30
A 15m	NA	NA	196 +- 20	221 +- 22	830 +- 30
A 20m	NA	NA	145 +- 14	157 +- 16	600 +- 20
A 25m	NA	NA	130 +- 13	132 +- 13	520 +- 20
A 50m	NA	NA	121 +- 12	117 +- 12	480 +- 20
A 75m	NA	NA	129 +- 13	139 +- 14	540 +- 20
A 100m	NA	NA	125 +- 12	116 +- 12	480 +- 20
A 118m	NA	NA	145 +- 14	135 +- 14	560 +- 20
B 5m	NA	NA	208 +- 21	215 +- 22	850 +- 30
B 10m	NA	NA	187 +- 19	198 +- 20	770 +- 30
B 15m	NA	NA	175 +- 18	181 +- 18	710 +- 30
B 20m	NA	NA	192 +- 19	196 +- 20	780 +- 30
B 25m	NA	NA	196 +- 20	198 +- 20	790 +- 30
B 50m	NA	NA	183 +- 18	185 +- 18	740 +- 30
B 75m	NA	NA	174 +- 17	182 +- 18	710 +- 20
B 100m	NA	NA	186 +- 19	212 +- 21	800 +- 30
B 150m	NA	NA	164 +- 16	173 +- 17	670 +- 20
B 200m	NA	NA	192 +- 19	200 +- 20	780 +- 30

NA : Data not Available - Lost or destroyed TLD, or site not in use for this collection interval.

Locations beginning with 'A' extend North from the perimeter fence.

Locations beginning with 'B' extend West from the perimeter fence.

TABLE 3.06 92-03-04
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Year
1991

Beach Surveys, Ion Chamber uSv/h * Intertidal Zones

Location	Quarter 1	Quarter 2	Quarter 3	Quarter 4
B01	0.12	0.14	0.20	0.19
C01	0.12	0.08	0.15	0.17
D01	0.14	0.08	0.14	0.14
D04	0.14	0.14	0.16	0.16
E03	0.14	0.15	0.12	0.14
G01	0.21	0.20	0.17	0.22
H03	0.15	0.20	0.09	0.20
N04	0.14	0.17	0.16	0.21
P02	0.18	0.16	0.15	0.20
Q01R	0.22	0.19	0.16	0.12

* : Although two decimal places are quoted, none of the determinations has this degree of precision nor of accuracy. The data are quoted to two figures just as they are estimated at each location. They should be regarded as about 0.1 to 0.2 microgray/h.

TABLE 3.07A
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

92-03-04

Sediment Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (40)	6.1E+000 (4.3E+000 - 1.0E+001)	*		*	*
Ce-141 (40)	1.5E+000 (1.1E+000 - 2.9E+000)	*		*	*
Cr-51 (40)	8.1E+000 (5.5E+000 - 1.3E+001)	*		*	*
I-131 (40)	1.4E+000 (8.2E-001 - 2.8E+000)	*		*	*
Be-7 (40)	8.4E+000 (4.7E+000 - 1.5E+001)	3.1E+001 (9/36) (1.4E+001 - 5.4E+001)	D04	4.3E+001 (2/4) (3.3E+001 - 5.4E+001)	1.7E+001 (3/4) (1.0E+001 - 2.4E+001)
Ru-103 (40)	8.9E-001 (6.3E-001 - 1.5E+000)	*		*	*
Ba-140 (40)	4.2E+000 (2.7E+000 - 7.2E+000)	*		*	*
Cs-134 (40)	8.5E-001 (6.2E-001 - 1.5E+000)	*		*	*
Ru-106 (40)	7.9E+000 (4.9E+000 - 1.3E+001)	*		*	*
Cs-137 (40)	1.1E+000 (7.3E-001 - 1.9E+000)	4.2E+000 (9/36) (1.9E+000 - 6.7E+000)	D04	4.6E+000 (3/4) (1.9E+000 - 6.7E+000)	1.9E+000 (1/4) (1.9E+000 - 1.9E+000)
Zr-95 (40)	1.8E+000 (1.3E+000 - 3.4E+000)	*		*	*
Nb-95 (40)	9.7E-001 (6.4E-001 - 1.9E+000)	*		*	*
Co-58 (40)	9.1E-001 (5.0E-001 - 2.1E+000)	*		*	*
Mn-54 (40)	9.6E-001 (5.2E-001 - 1.8E+000)	*		*	*

TABLE 3.07A (Cont'd) 92-03-04
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Sediment Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (40)	1.3E+000 (8.9E-001 - 2.3E+000)	*		*	*
Ac-228 (40)	3.6E+000 (2.4E+000 - 6.6E+000)	2.0E+001 (36/36) (1.0E+001 - 3.8E+001)	D01	3.1E+001 (4/4) (2.7E+001 - 3.4E+001)	2.2E+001 (4/4) (1.3E+001 - 3.2E+001)
Fe-59 (40)	2.4E+000 (1.5E+000 - 4.5E+000)	*		*	*
Zn-65 (40)	2.6E+000 (2.0E+000 - 4.3E+000)	*		*	*
Co-60 (40)	1.1E+000 (7.4E-001 - 2.0E+000)	*		*	*
K-40 (40)	9.8E+000 (4.6E+000 - 1.7E+001)	5.4E+002 (36/36) (4.4E+002 - 7.3E+002)	D01	6.1E+002 (4/4) (5.9E+002 - 6.3E+002)	4.7E+002 (4/4) (4.5E+002 - 4.8E+002)
La-140 (40)	1.3E+000 (4.2E-001 - 2.6E+000)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 3.07B
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
1978 to 1991

Cs-137 in Sediment Bq/kg

LOCATION	B01	C01	D01	D04	E03	G01	N03	N04	P02	Q01R
Sed. type	*	+	+	+	*	*	*	*	*	+
Year										
1978	<1.3	3.6	7.8	--	<5.0	<2.1	<1.5	<2.1	<1.6	7.0
1979 #	<0.9	4.9	5.3	6.9	<1.2	<2.6	<1.6	<2.1	<1.2	5.4
1980 #	<1.5	3.0	4.2	11.3	<1.2	<2.5	<1.2	<1.2	<2.3	5.6
1981 #	<1.4	2.4	3.9	9.9	<1.0	<1.4	<1.3	<2.1	<1.2	5.3
1982 #	<1.0	3.5	5.8	6.7	<1.6	<2.9	<1.5	<2.3	<2.1	5.8
1983 #	<1.5	<2.0	4.3	5.8	<1.2	<4.5	<2.2	<3.1	<1.5	<4.6
1984 #	<1.5	<2.8	3.4	7.2	<1.7	<3.3	<1.5	<1.9	<2.0	3.8
1985 #	<1.1	<1.6	3.8	5.7	<1.2	<1.6	<1.5	<1.4	<1.4	<1.8
1986 #	<1.7	2.6	5.0	6.9	<1.3	<1.7	<1.4	3.0	<1.1	<2.8
1987 #	<1.3	3.0	3.4	5.7	<1.2	<2.0	<1.2	<1.5	<1.3	<2.2
1988 #	<1.5	2.0	5.0	4.4	<1.4	<2.2	<1.3	<1.9	<1.7	<2.6
1989 #	<1.4	<3.1	5.1	8.7	<1.6	<2.6	<1.3	<3.0	<1.4	<2.8
1990 #	<1.7	<2.5	<4.8	5.4	<1.8	<2.7	<2.3	<2.0	<1.1	<3.1
1991 #	<1.1	<2.7	4.6	3.9	<1.6	<1.5	<1.3	<2.3	<2.0	<2.8

< : not detected.

* : coarse grained sediment.

+ : fine grained sediment.

: average of 4 quarterly samples.

-- : not sampled.

92-03-04

TABLE 3.08
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Well Water Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
ALPHA (24)	6.9E-002 (2.0E-002 - 2.6E-001)	1.8E-001 (14/22) (2.6E-002 - 4.3E-001)	N01	4.3E-001 (2/2) (4.2E-001 - 4.3E-001)	8.1E-002 (1/2) (8.1E-002 - 8.1E-002)
BETA (24)	4.4E-002 (2.2E-002 - 1.1E-001)	1.5E-001 (20/22) (4.9E-002 - 2.9E-001)	N04	2.7E-001 (2/2) (2.6E-001 - 2.9E-001)	9.0E-002 (2/2) (7.8E-002 - 1.0E-001)
H-3 (24)	1.2E+001 (1.2E+001 - 1.2E+001)	1.6E+001 (6/22) (1.2E+001 - 2.4E+001)	N03	1.9E+001 (2/2) (1.4E+001 - 2.4E+001)	*
Ce-144 (24)	1.6E+000 (9.5E-001 - 3.2E+000)	*		*	*
Ce-141 (24)	3.7E-001 (2.2E-001 - 7.4E-001)	*		*	*
Cr-51 (24)	1.6E+000 (9.2E-001 - 3.2E+000)	*		*	*
I-131 (24)	2.3E-001 (1.3E-001 - 4.3E-001)	*		*	*
Be-7 (24)	1.4E+000 (7.7E-001 - 2.9E+000)	*		*	*
Ru-103 (24)	1.8E-001 (1.1E-001 - 2.8E-001)	*		*	*
Ba-140 (24)	7.3E-001 (4.3E-001 - 1.3E+000)	*		*	*
Cs-134 (24)	1.6E-001 (1.1E-001 - 3.0E-001)	*		*	*
Ru-106 (24)	1.5E+000 (7.4E-001 - 2.7E+000)	*		*	*
Cs-137 (24)	1.7E-001 (7.7E-002 - 2.9E-001)	*		*	*
Zr-95 (24)	2.9E-001 (1.8E-001 - 4.9E-001)	*		*	*

TABLE 3.08 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

92-03-04

Well Water Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Nb-95 (24)	1.6E-001 (9.0E-002 - 2.8E-001)	*		*	*
Co-58 (24)	1.7E-001 (9.5E-002 - 3.1E-001)	*		*	*
Mn-54 (24)	1.6E-001 (9.2E-002 - 3.0E-001)	*		*	*
Ag-110m (24)	2.0E-001 (6.4E-002 - 3.9E-001)	*		*	*
Ac-228 (24)	6.1E-001 (2.9E-001 - 1.3E+000)	1.0E+000 (1/22) (1.0E+000 - 1.0E+000)	D03	1.0E+000 (1/3) (1.0E+000 - 1.0E+000)	*
Fe-59 (24)	3.5E-001 (1.5E-001 - 6.6E-001)	*		*	*
Zn-65 (24)	3.6E-001 (2.0E-001 - 6.7E-001)	*		*	*
Co-60 (24)	1.7E-001 (6.7E-002 - 3.4E-001)	*		*	*
K-40 (24)	2.3E+000 (1.5E+000 - 3.8E+000)	*		*	*
La-140 (24)	2.3E-001 (9.1E-002 - 4.9E-001)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 3.09
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Bore Hole Water - SRWMF Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
H-3 (11)	1.2E+001 (1.1E+001 - 1.3E+001)	1.0E+002 (11/11) (3.8E+001 - 1.8E+002)	1008	1.5E+002 (4/4) (9.8E+001 - 1.8E+002)	*
Ce-144 (11)	1.0E+000 (8.9E-001 - 1.2E+000)	*		*	*
Ce-141 (11)	2.4E-001 (2.2E-001 - 2.7E-001)	*		*	*
Cr-51 (11)	1.2E+000 (8.6E-001 - 1.5E+000)	*		*	*
I-131 (11)	1.7E-001 (1.3E-001 - 2.1E-001)	*		*	*
Be-7 (11)	1.1E+000 (7.6E-001 - 1.2E+000)	*		*	*
Ru-103 (11)	1.3E-001 (1.2E-001 - 1.6E-001)	*		*	*
Ba-140 (11)	5.7E-001 (3.9E-001 - 7.2E-001)	*		*	*
Cs-134 (11)	1.2E-001 (8.8E-002 - 1.7E-001)	*		*	*
Ru-106 (11)	1.1E+000 (8.3E-001 - 1.2E+000)	*		*	*
Cs-137 (11)	1.3E-001 (8.9E-002 - 1.7E-001)	*		*	*
Zr-95 (11)	2.2E-001 (1.8E-001 - 2.7E-001)	*		*	*
Nb-95 (11)	1.3E-001 (1.0E-001 - 1.6E-001)	*		*	*
Co-58 (11)	1.2E-001 (9.1E-002 - 1.5E-001)	*		*	*

TABLE 3.09 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

92-03-04

Bore Hole Water - SRUMF Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Mn-54 (11)	1.2E-001 (6.5E-002 - 1.7E-001)	*		*	*
Ag-110m (11)	1.6E-001 (1.1E-001 - 2.1E-001)	*		*	*
Ac-228 (11)	4.9E-001 (3.4E-001 - 5.9E-001)	*		*	*
Fe-59 (11)	2.4E-001 (1.8E-001 - 3.1E-001)	*		*	*
Zn-65 (11)	2.9E-001 (1.6E-001 - 4.5E-001)	*		*	*
Co-60 (11)	1.5E-001 (1.2E-001 - 1.9E-001)	*		*	*
K-40 (11)	2.1E+000 (7.8E-001 - 3.0E+000)	2.4E+000 (1/11) (2.4E+000 - 2.4E+000)	100C	2.4E+000 (1/4) (2.4E+000 - 2.4E+000)	*
La-140 (11)	1.7E-001 (1.3E-001 - 2.6E-001)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

92-03-0

TABLE 3.10
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Bore Hole Water - DFS Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
H-3 (28)	1.2E+001 (1.1E+001 - 1.4E+001)	4.5E+001 (25/28) (1.4E+001 - 1.0E+002)	103K	7.3E+001 (2/2) (4.3E+001 - 1.0E+002)	*
Ce-144 (28)	1.3E+000 (8.6E-001 - 1.9E+000)	*		*	*
Ce-141 (28)	3.1E-001 (2.1E-001 - 4.7E-001)	*		*	*
Cr-51 (28)	1.5E+000 (1.0E+000 - 2.9E+000)	*		*	*
I-131 (28)	2.3E-001 (1.5E-001 - 4.5E-001)	*		*	*
Be-7 (28)	1.4E+000 (8.6E-001 - 2.8E+000)	*		*	*
Ru-103 (28)	1.6E-001 (9.7E-002 - 3.8E-001)	*		*	*
Ba-140 (28)	7.0E-001 (4.2E-001 - 1.5E+000)	*		*	*
Cs-134 (28)	1.5E-001 (8.1E-002 - 3.0E-001)	*		*	*
Ru-106 (28)	1.4E+000 (7.4E-001 - 2.6E+000)	*		*	*
Cs-137 (28)	1.6E-001 (1.0E-001 - 3.2E-001)	*		*	*
Zr-95 (28)	2.9E-001 (1.4E-001 - 6.3E-001)	*		*	*
Nb-95 (28)	1.5E-001 (7.8E-002 - 2.7E-001)	*		*	*
Co-58 (28)	1.6E-001 (9.3E-002 - 3.5E-001)	*		*	*

TABLE 3.10 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Bore Hole Water - DFS Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Mn-54 (28)	1.5E-001 (8.0E-002 - 3.1E-001)	*		*	*
Ag-110m (28)	2.0E-001 (1.1E-001 - 3.9E-001)	*		*	*
Ac-228 (28)	6.5E-001 (3.8E-001 - 1.8E+000)	1.3E+000 (1/28) (1.3E+000 - 1.3E+000)	103G	1.3E+000 (1/2) (1.3E+000 - 1.3E+000)	*
Fe-59 (28)	3.4E-001 (1.9E-001 - 6.8E-001)	*		*	*
Zn-65 (28)	3.2E-001 (1.2E-001 - 7.5E-001)	*		*	*
Co-60 (28)	1.5E-001 (9.5E-002 - 2.9E-001)	*		*	*
K-40 (28)	2.3E+000 (7.8E-001 - 5.7E+000)	3.6E+000 (4/28) (2.8E+000 - 4.6E+000)	103A	4.6E+000 (1/2) (4.6E+000 - 4.6E+000)	*
La-140 (28)	2.4E-001 (1.1E-001 - 4.1E-001)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 3.11
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

92-03-04

Parshall Flume - SRWMF Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
H-3 (53)	1.2E+001 (1.1E+001 - 1.4E+001)	3.7E+002 (53/53) (7.4E+001 - 1.0E+003)	101	3.7E+002 (53/53) (7.4E+001 - 1.0E+003)	*
Ce-144 (53)	1.0E+000 (8.6E-001 - 2.3E+000)	*		*	*
Ce-141 (53)	2.4E-001 (2.0E-001 - 6.7E-001)	*		*	*
Cr-51 (53)	1.2E+000 (8.9E-001 - 4.1E+000)	*		*	*
I-131 (53)	1.7E-001 (1.1E-001 - 8.2E-001)	*		*	*
Be-7 (53)	1.2E+000 (7.1E-001 - 3.0E+000)	*		*	*
Ru-103 (53)	1.4E-001 (1.0E-001 - 3.8E-001)	*		*	*
Ba-140 (53)	5.4E-001 (3.8E-001 - 1.6E+000)	*		*	*
Cs-134 (53)	1.2E-001 (8.0E-002 - 3.4E-001)	*		*	*
Ru-106 (53)	1.2E+000 (6.4E-001 - 3.0E+000)	*		*	*
Cs-137 (53)	1.4E-001 (7.7E-002 - 3.9E-001)	*		*	*
Zr-95 (53)	2.2E-001 (1.4E-001 - 5.6E-001)	*		*	*
Nb-95 (53)	1.2E-001 (7.5E-002 - 3.4E-001)	*		*	*
Co-58 (53)	1.2E-001 (7.9E-002 - 4.0E-001)	*		*	*

TABLE 3.11 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

92-03-04

Parshall Flume - SRWMF Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Mn-54 (53)	1.2E-001 (6.5E-002 - 3.0E-001)	*		*	*
Ag-110m (53)	1.7E-001 (9.1E-002 - 5.1E-001)	*		*	*
Ac-228 (53)	5.0E-001 (2.4E-001 - 1.1E+000)	1.3E+000 (1/53) (1.3E+000 - 1.3E+000)	I01	1.3E+000 (1/53) (1.3E+000 - 1.3E+000)	*
Fe-59 (53)	2.7E-001 (1.1E-001 - 8.2E-001)	*		*	*
Zn-65 (53)	2.9E-001 (1.1E-001 - 8.5E-001)	*		*	*
Co-60 (53)	1.5E-001 (6.7E-002 - 2.9E-001)	*		*	*
K-40 (53)	2.2E+000 (1.2E+000 - 4.7E+000)	*		*	*
La-140 (53)	1.9E-001 (8.7E-002 - 7.5E-001)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

92-03-04

TABLE 3.12
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Parshall Flume - DFS Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
H-3 (21)	1.2E+001 (1.1E+001 - 1.2E+001)	6.6E+001 (21/21) (2.3E+001 - 1.7E+002)	102	6.6E+001 (21/21) (2.3E+001 - 1.7E+002)	*
Ce-144 (21)	1.6E+000 (1.1E+000 - 1.9E+000)	*		*	*
Ce-141 (21)	4.3E-001 (3.0E-001 - 5.3E-001)	*		*	*
Cr-51 (21)	2.5E+000 (1.2E+000 - 3.1E+000)	*		*	*
I-131 (21)	5.0E-001 (2.0E-001 - 6.7E-001)	*		*	*
Be-7 (21)	2.3E+000 (1.4E+000 - 3.2E+000)	*		*	*
Ru-103 (21)	2.9E-001 (1.4E-001 - 3.9E-001)	*		*	*
Ba-140 (21)	1.4E+000 (6.4E-001 - 2.3E+000)	*		*	*
Cs-134 (21)	2.7E-001 (1.4E-001 - 3.5E-001)	*		*	*
Ru-106 (21)	2.1E+000 (8.1E-001 - 2.8E+000)	*		*	*
Cs-137 (21)	2.5E-001 (1.3E-001 - 3.2E-001)	*		*	*
Zr-95 (21)	4.4E-001 (2.3E-001 - 6.3E-001)	*		*	*
Nb-95 (21)	2.6E-001 (1.4E-001 - 3.8E-001)	*		*	*
Co-58 (21)	2.4E-001 (1.0E-001 - 3.2E-001)	*		*	*

TABLE 3.12 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

92-03-04

Parshall Flume - DFS Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Mn-54 (21)	2.4E-001 (1.1E-001 - 3.2E-001)	*		*	*
Ag-110m (21)	3.4E-001 (1.4E-001 - 4.9E-001)	*		*	*
Ac-228 (21)	9.7E-001 (5.6E-001 - 1.4E+000)	*		*	*
Fe-59 (21)	5.9E-001 (2.8E-001 - 8.4E-001)	*		*	*
Zn-65 (21)	5.5E-001 (2.5E-001 - 9.2E-001)	*		*	*
Co-60 (21)	3.0E-001 (9.5E-002 - 4.6E-001)	*		*	*
K-40 (21)	4.1E+000 (1.7E+000 - 5.6E+000)	7.6E+000 (1/21) (7.6E+000 - 7.6E+000)	102	7.6E+000 (1/21) (7.6E+000 - 7.6E+000)	*
La-140 (21)	4.7E-001 (1.7E-001 - 6.8E-001)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

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TABLE 3.13
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Lagoon Water Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
H-3 (34)	1.5E+001 (1.1E+001 - 3.1E+001)	6.3E+003 (34/34) (2.6E+001 - 3.5E+004)	K03W	1.0E+004 (10/10) (1.2E+003 - 3.5E+004)	*
Gd-153 (34)	7.3E-001 (5.8E-001 - 8.8E-001)	*		*	*
Ce-144 (34)	1.6E+000 (1.4E+000 - 2.0E+000)	*		*	*
Mo-99 (34)	6.5E-001 (3.1E-001 - 9.5E-001)	*		*	*
Ce-141 (34)	4.2E-001 (3.5E-001 - 4.8E-001)	*		*	*
Np-239 (34)	5.6E+000 (2.4E+000 - 9.3E+000)	*		*	*
Cr-51 (34)	2.4E+000 (1.8E+000 - 3.1E+000)	*		*	*
Gd-159 (34)	1.5E+002 (1.4E+001 - 4.4E+002)	*		*	*
I-131 (34)	3.8E-001 (2.8E-001 - 5.0E-001)	*		*	*
Ru-103 (34)	2.8E-001 (2.0E-001 - 3.8E-001)	*		*	*
Ba-140 (34)	1.2E+000 (8.4E-001 - 1.6E+000)	*		*	*
Cs-134 (34)	2.4E-001 (1.7E-001 - 3.3E-001)	*		*	*
Ru-106 (34)	2.4E+000 (1.4E+000 - 3.2E+000)	*		*	*
Cs-137 (34)	2.8E-001 (1.4E-001 - 3.6E-001)	*		*	*

TABLE 3.13 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

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Lagoon Water Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Zr-95 (34)	4.7E-001 (2.4E-001 - 6.0E-001)	*		*	*
Nb-95 (34)	2.5E-001 (1.3E-001 - 3.7E-001)	*		*	*
Co-58 (34)	2.4E-001 (1.4E-001 - 3.8E-001)	*		*	*
Mn-54 (34)	2.4E-001 (1.0E-001 - 4.0E-001)	*		*	*
Ag-110m (34)	3.5E-001 (2.0E-001 - 5.1E-001)	*		*	*
Sc-46 (34)	2.4E-001 (1.1E-001 - 4.3E-001)	*		*	*
Fe-59 (34)	5.4E-001 (2.3E-001 - 8.1E-001)	*		*	*
Zn-65 (34)	6.0E-001 (2.5E-001 - 8.7E-001)	*		*	*
Co-60 (34)	3.0E-001 (2.1E-001 - 4.1E-001)	*		*	*
La-140 (34)	4.0E-001 (2.0E-001 - 5.9E-001)	*		*	*
Sb-124 (34)	6.0E-001 (3.9E-001 - 1.0E+000)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 3.14
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

92-03-04

Sea Water Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
H-3 (16)	1.2E+001 (1.1E+001 - 1.2E+001)	2.2E+001 (1/12) (2.2E+001 - 2.2E+001)	H03	2.2E+001 (1/4) (2.2E+001 - 2.2E+001)	*
Ce-144 (16)	1.0E+000 (9.2E-001 - 1.2E+000)	*		*	*
Ce-141 (16)	2.4E-001 (2.0E-001 - 3.0E-001)	*		*	*
Cr-51 (16)	1.2E+000 (8.4E-001 - 1.3E+000)	*		*	*
I-131 (16)	1.6E-001 (1.2E-001 - 2.3E-001)	*		*	*
Be-7 (16)	1.0E+000 (7.6E-001 - 1.3E+000)	*		*	*
Ru-103 (16)	1.4E-001 (1.2E-001 - 1.6E-001)	*		*	*
Ba-140 (16)	5.4E-001 (4.5E-001 - 7.1E-001)	*		*	*
Cs-134 (16)	1.2E-001 (7.2E-002 - 1.5E-001)	*		*	*
Ru-106 (16)	1.1E+000 (9.0E-001 - 1.6E+000)	*		*	*
Cs-137 (16)	1.4E-001 (8.9E-002 - 1.7E-001)	*		*	*
Zr-95 (16)	2.3E-001 (1.2E-001 - 3.0E-001)	*		*	*
Nb-95 (16)	1.2E-001 (6.2E-002 - 1.7E-001)	*		*	*
Co-58 (16)	1.1E-001 (7.9E-002 - 1.6E-001)	*		*	*

TABLE 3.14 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

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Sea Water Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Mn-54 (16)	1.3E-001 (8.0E-002 - 1.6E-001)	*		*	*
Ag-110m (16)	1.7E-001 (1.3E-001 - 2.1E-001)	*		*	*
Ac-228 (16)	4.7E-001 (2.9E-001 - 5.9E-001)	*		*	*
Fe-59 (16)	2.9E-001 (1.9E-001 - 4.0E-001)	*		*	*
Zn-65 (16)	2.8E-001 (1.2E-001 - 4.2E-001)	*		*	*
Co-60 (16)	1.5E-001 (6.7E-002 - 2.1E-001)	*		*	*
K-40 (16)	1.2E+000 (0.0E+001 - 1.9E+000)	1.1E+001 (12/12) (4.9E+000 - 1.4E+001)	H05	1.3E+001 (4/4) (1.2E+001 - 1.3E+001)	1.1E+001 (4/4) (9.0E+000 - 1.2E+001)
La-140 (16)	1.7E-001 (9.0E-002 - 2.6E-001)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

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TABLE 3.15
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Milk Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
H-3 (19)	1.2E+001 (1.1E+001 - 1.2E+001)	*		*	*
Ce-144 (20)	3.6E-001 (3.4E-001 - 3.8E-001)	*		*	*
Ce-141 (20)	8.3E-002 (7.8E-002 - 1.1E-001)	*		*	*
Cr-51 (20)	4.2E-001 (3.8E-001 - 5.7E-001)	*		*	*
I-131 (20)	6.5E-002 (4.9E-002 - 1.8E-001)	*		*	*
Be-7 (20)	4.0E-001 (3.6E-001 - 4.9E-001)	*		*	*
Ru-103 (20)	4.7E-002 (4.3E-002 - 5.7E-002)	*		*	*
Ba-140 (20)	2.0E-001 (1.7E-001 - 3.7E-001)	*		*	*
Cs-134 (20)	4.3E-002 (4.0E-002 - 4.7E-002)	*		*	*
Ru-106 (20)	4.3E-001 (3.9E-001 - 4.6E-001)	*		*	*
Cs-137 (20)	5.4E-002 (4.3E-002 - 6.0E-002)	9.7E-002 (3/7) (8.0E-002 - 1.1E-001)	A04	9.7E-002 (3/3) (8.0E-002 - 1.1E-001)	*
Zr-95 (20)	8.4E-002 (6.8E-002 - 1.0E-001)	*		*	*
Nb-95 (20)	4.7E-002 (4.2E-002 - 5.8E-002)	*		*	*
Co-58 (20)	4.8E-002 (4.3E-002 - 5.5E-002)	*		*	*

TABLE 3.15 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

92-03-04

Milk Bq/L

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Mn-54 (20)	4.8E-002 (4.4E-002 - 5.2E-002)	*		*	*
Ag-110m (20)	6.5E-002 (5.8E-002 - 7.3E-002)	*		*	*
Ac-228 (20)	1.9E-001 (1.7E-001 - 2.0E-001)	*		*	*
Fe-59 (20)	1.3E-001 (1.1E-001 - 1.6E-001)	*		*	*
Zn-65 (20)	1.3E-001 (1.2E-001 - 1.5E-001)	*		*	*
Co-60 (20)	5.7E-002 (5.2E-002 - 6.2E-002)	*		*	*
K-40 (20)	5.6E-001 (5.0E-001 - 6.2E-001)	5.5E+001 (7/7) (5.3E+001 - 5.8E+001)	A04	5.6E+001 (3/3) (5.4E+001 - 5.8E+001)	5.2E+001 (13/13) (4.9E+001 - 5.4E+001)
La-140 (20)	5.6E-002 (4.2E-002 - 1.0E-001)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

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TABLE 3.16
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Clams, Edible, Raw Mass Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (10)	2.5E+001 (2.0E+001 - 3.4E+001)	*		*	*
Ce-141 (10)	5.8E+000 (4.4E+000 - 6.7E+000)	*		*	*
Cr-51 (10)	3.0E+001 (2.2E+001 - 4.3E+001)	*		*	*
I-131 (10)	4.3E+000 (3.7E+000 - 5.7E+000)	*		*	*
Be-7 (10)	3.3E+001 (2.3E+001 - 4.4E+001)	*		*	*
Ru-103 (10)	4.2E+000 (3.5E+000 - 4.9E+000)	*		*	*
Ba-140 (10)	1.5E+001 (1.2E+001 - 1.8E+001)	*		*	*
Cs-134 (10)	3.7E+000 (2.3E+000 - 4.9E+000)	*		*	*
Ru-106 (10)	3.6E+001 (2.7E+001 - 4.7E+001)	*		*	*
Cs-137 (10)	3.9E+000 (2.4E+000 - 5.2E+000)	*		*	*
Zr-95 (10)	6.5E+000 (3.0E+000 - 9.7E+000)	*		*	*
Nb-95 (10)	3.6E+000 (2.2E+000 - 4.5E+000)	*		*	*
Co-58 (10)	3.5E+000 (2.6E+000 - 4.4E+000)	*		*	*
Mn-54 (10)	3.6E+000 (2.7E+000 - 5.5E+000)	*		*	*

TABLE 3.16 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Clams, Edible, Raw Mass Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (10)	5.0E+000 (3.8E+000 - 6.3E+000)	*		*	*
Ac-228 (10)	2.0E+001 (1.1E+001 - 2.8E+001)	4.0E+001 (1/10) (4.0E+001 - 4.0E+001)	C01	4.0E+001 (1/4) (4.0E+001 - 4.0E+001)	*
Fe-59 (10)	8.3E+000 (6.6E+000 - 1.2E+001)	*		*	*
Zn-65 (10)	8.4E+000 (4.8E+000 - 1.2E+001)	*		*	*
Co-60 (10)	4.4E+000 (2.4E+000 - 6.3E+000)	*		*	*
K-40 (10)	3.6E+001 (2.0E+001 - 5.1E+001)	2.3E+002 (10/10) (1.3E+002 - 3.0E+002)	C01	2.7E+002 (4/4) (2.5E+002 - 3.0E+002)	*
La-140 (10)	4.5E+000 (2.5E+000 - 6.2E+000)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 3.17
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Crab, Edible, Cooked Mass Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (3)	5.5E+001 (4.6E+001 - 6.1E+001)	*		*	*
Ce-141 (3)	1.7E+001 (1.4E+001 - 2.0E+001)	*		*	*
Cr-51 (3)	1.2E+002 (9.8E+001 - 1.4E+002)	*		*	*
I-131 (3)	5.5E+001 (3.4E+001 - 8.5E+001)	*		*	*
Be-7 (3)	9.1E+001 (7.0E+001 - 1.1E+002)	*		*	*
Ru-103 (3)	1.2E+001 (1.0E+001 - 1.5E+001)	*		*	*
Ba-140 (3)	1.0E+002 (7.3E+001 - 1.7E+002)	*		*	*
Cs-134 (3)	8.6E+000 (7.0E+000 - 1.1E+001)	*		*	*
Ru-106 (3)	6.5E+001 (5.8E+001 - 7.6E+001)	*		*	*
Cs-137 (3)	7.7E+000 (6.9E+000 - 9.3E+000)	*		*	*
Zr-95 (3)	1.3E+001 (9.3E+000 - 1.6E+001)	*		*	*
Nb-95 (3)	8.0E+000 (5.9E+000 - 1.2E+001)	*		*	*
Co-58 (3)	9.9E+000 (6.9E+000 - 1.3E+001)	*		*	*
Mn-54 (3)	8.9E+000 (6.8E+000 - 1.0E+001)	*		*	*

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TABLE 3.17 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Crab, Edible, Cooked Mass Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (3)	1.1E+001 (9.6E+000 - 1.3E+001)	*		*	*
Ac-228 (3)	3.4E+001 (2.6E+001 - 4.0E+001)	*		*	*
Fe-59 (3)	1.8E+001 (1.4E+001 - 2.4E+001)	*		*	*
Zn-65 (3)	2.1E+001 (1.4E+001 - 2.7E+001)	*		*	*
Co-60 (3)	8.8E+000 (8.0E+000 - 9.6E+000)	*		*	*
K-40 (3)	6.9E+001 (5.2E+001 - 8.8E+001)	6.9E+002 (3/3) (6.8E+002 - 7.2E+002)	H02	6.9E+002 (3/3) (6.8E+002 - 7.2E+002)	*
La-140 (3)	2.4E+001 (1.2E+001 - 3.6E+001)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

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TABLE 3.18
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Dulse, Wet Mass Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (4)	5.3E+000 (3.5E+000 - 9.2E+000)	*		*	*
Ce-141 (4)	1.1E+000 (6.8E-001 - 1.9E+000)	*		*	*
Cr-51 (4)	6.1E+000 (4.1E+000 - 9.5E+000)	*		*	*
I-131 (4)	9.0E-001 (5.0E-001 - 1.7E+000)	*		*	*
Be-7 (4)	7.2E+000 (4.6E+000 - 1.1E+001)	*		*	*
Ru-103 (4)	8.0E-001 (4.6E-001 - 1.3E+000)	*		*	*
Ba-140 (4)	3.3E+000 (2.0E+000 - 5.9E+000)	*		*	*
Cs-134 (4)	7.6E-001 (5.3E-001 - 1.3E+000)	*		*	*
Ru-106 (4)	7.0E+000 (4.5E+000 - 1.0E+001)	*		*	*
Cs-137 (4)	1.0E+000 (6.6E-001 - 1.6E+000)	*		*	*
Zr-95 (4)	1.4E+000 (7.9E-001 - 2.5E+000)	*		*	*
Nb-95 (4)	8.5E-001 (5.1E-001 - 1.5E+000)	*		*	*
Co-58 (4)	8.8E-001 (5.6E-001 - 1.6E+000)	*		*	*
Mn-54 (4)	9.6E-001 (5.7E-001 - 1.6E+000)	*		*	*

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TABLE 3.18 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Dulse, Wet Mass Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (4)	1.3E+000 (7.7E-001 - 1.9E+000)	*		*	*
Ac-228 (4)	3.3E+000 (2.4E+000 - 5.0E+000)	*		*	*
Fe-59 (4)	2.7E+000 (1.8E+000 - 4.7E+000)	*		*	*
Zn-65 (4)	2.3E+000 (1.8E+000 - 2.9E+000)	*		*	*
Co-60 (4)	1.1E+000 (6.4E-001 - 1.8E+000)	*		*	*
K-40 (4)	8.0E+000 (6.1E+000 - 1.2E+001)	5.3E+002 (4/4) (4.3E+002 - 6.0E+002)	E03	5.6E+002 (2/2) (5.1E+002 - 6.0E+002)	*
La-140 (4)	9.5E-001 (2.9E-001 - 2.1E+000)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

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TABLE 3.19
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Fish, Various, Edible,Raw Mass Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (7)	5.0E+000 (4.0E+000 - 8.1E+000)	*		*	*
Ce-141 (7)	1.5E+000 (1.0E+000 - 2.9E+000)	*		*	*
Cr-51 (7)	8.9E+000 (5.5E+000 - 1.6E+001)	*		*	*
I-131 (7)	3.6E+000 (8.4E-001 - 8.7E+000)	*		*	*
Be-7 (7)	8.2E+000 (7.2E+000 - 9.8E+000)	*		*	*
Ru-103 (7)	9.8E-001 (6.6E-001 - 1.7E+000)	*		*	*
Ba-140 (7)	6.3E+000 (3.0E+000 - 1.4E+001)	*		*	*
Cs-134 (7)	6.7E-001 (4.6E-001 - 9.5E-001)	*		*	*
Ru-106 (7)	7.1E+000 (5.1E+000 - 9.2E+000)	*		*	*
Cs-137 (7)	8.9E-001 (6.2E-001 - 1.5E+000)	*		*	*
Zr-95 (7)	1.5E+000 (6.9E-001 - 2.8E+000)	*		*	*
Nb-95 (7)	8.6E-001 (4.7E-001 - 1.5E+000)	*		*	*
Co-58 (7)	7.6E-001 (3.0E-001 - 1.4E+000)	*		*	*
Mn-54 (7)	8.4E-001 (5.7E-001 - 1.3E+000)	*		*	*

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TABLE 3.19 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Fish, Various, Edible,Raw Mass Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (7)	1.1E+000 (7.1E-001 - 1.5E+000)	*		*	*
Ac-228 (7)	3.0E+000 (1.9E+000 - 4.1E+000)	*		*	*
Fe-59 (7)	2.6E+000 (1.8E+000 - 5.0E+000)	*		*	*
Zn-65 (7)	2.2E+000 (1.5E+000 - 3.9E+000)	*		*	*
Co-60 (7)	8.7E-001 (5.3E-001 - 1.2E+000)	*		*	*
K-40 (7)	8.5E+000 (6.5E+000 - 1.2E+001)	1.2E+002 (7/7) (1.1E+002 - 1.3E+002)	N06	1.3E+002 (1/1) (1.3E+002 - 1.3E+002)	*
La-140 (7)	2.0E+000 (1.1E+000 - 4.9E+000)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 3.20
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

92-03-04

Lobster, Edible, Cooked Mass Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (7)	1.1E+001 (7.4E+000 - 1.4E+001)	*		*	*
Ce-141 (7)	3.5E+000 (2.0E+000 - 4.8E+000)	*		*	*
Cr-51 (7)	2.2E+001 (1.2E+001 - 3.2E+001)	*		*	*
I-131 (7)	1.0E+001 (4.7E+000 - 2.5E+001)	*		*	*
Be-7 (7)	1.8E+001 (1.2E+001 - 2.9E+001)	*		*	*
Ru-103 (7)	2.5E+000 (1.7E+000 - 3.9E+000)	*		*	*
Ba-140 (7)	2.1E+001 (6.7E+000 - 5.3E+001)	*		*	*
Cs-134 (7)	1.8E+000 (1.3E+000 - 2.2E+000)	*		*	*
Ru-106 (7)	1.7E+001 (8.4E+000 - 2.3E+001)	*		*	*
Cs-137 (7)	1.9E+000 (1.2E+000 - 2.3E+000)	*		*	*
Zr-95 (7)	3.4E+000 (2.1E+000 - 4.7E+000)	*		*	*
Nb-95 (7)	2.2E+000 (1.4E+000 - 3.0E+000)	*		*	*
Co-58 (7)	1.9E+000 (1.3E+000 - 2.4E+000)	*		*	*
Mn-54 (7)	1.6E+000 (1.4E+000 - 1.8E+000)	*		*	*

92-03-04

TABLE 3.20 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Lobster, Edible, Cooked Mass Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (7)	2.4E+000 (7.6E-001 - 3.4E+000)	*		*	*
Ac-228 (7)	6.0E+000 (3.9E+000 - 7.5E+000)	*		*	*
Fe-59 (7)	4.9E+000 (1.8E+000 - 6.8E+000)	*		*	*
Zn-65 (7)	4.8E+000 (3.6E+000 - 5.9E+000)	*		*	*
Co-60 (7)	2.0E+000 (1.3E+000 - 2.9E+000)	*		*	*
K-40 (7)	1.8E+001 (1.0E+001 - 2.9E+001)	1.1E+002 (7/7) (8.7E+001 - 1.5E+002)	H02	1.1E+002 (7/7) (8.7E+001 - 1.5E+002)	*
La-140 (7)	5.7E+000 (3.8E+000 - 8.2E+000)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 3.12
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Periwinkles, Edible, Raw Mass Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (11)	1.6E+001 (1.3E+001 - 1.8E+001)	*		*	*
Ce-141 (11)	4.6E+000 (3.5E+000 - 5.6E+000)	*		*	*
Cr-51 (11)	2.6E+001 (1.8E+001 - 3.9E+001)	*		*	*
I-131 (11)	8.4E+000 (3.0E+000 - 3.1E+001)	*		*	*
Be-7 (11)	2.4E+001 (1.4E+001 - 3.3E+001)	*		*	*
Ru-103 (11)	2.6E+000 (1.8E+000 - 3.6E+000)	*		*	*
Ba-140 (11)	1.8E+001 (1.2E+001 - 3.9E+001)	*		*	*
Cs-134 (11)	2.5E+000 (2.0E+000 - 2.9E+000)	*		*	*
Ru-106 (11)	2.2E+001 (1.8E+001 - 2.6E+001)	*		*	*
Cs-137 (11)	2.5E+000 (2.0E+000 - 3.2E+000)	*		*	*
Zr-95 (11)	4.3E+000 (2.4E+000 - 6.6E+000)	*		*	*
Nb-95 (11)	2.7E+000 (2.3E+000 - 3.4E+000)	*		*	*
Co-58 (11)	2.3E+000 (1.4E+000 - 3.2E+000)	*		*	*
Mn-54 (11)	2.3E+000 (1.6E+000 - 3.1E+000)	*		*	*

TABLE 3.12 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

92-03-04

Periwinkles, Edible, Raw Mass Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (11)	3.1E+000 (1.3E+000 - 4.5E+000)	*		*	*
Ac-228 (11)	1.0E+001 (6.7E+000 - 1.3E+001)	*		*	*
Fe-59 (11)	6.0E+000 (3.6E+000 - 7.1E+000)	*		*	*
Zn-65 (11)	5.8E+000 (3.9E+000 - 7.7E+000)	*		*	*
Co-60 (11)	2.8E+000 (1.3E+000 - 3.6E+000)	*		*	*
K-40 (11)	2.1E+001 (0.0E+001 - 3.0E+001)	1.3E+002 (11/11) (1.1E+002 - 2.0E+002)	N06	1.3E+002 (10/10) (1.1E+002 - 2.0E+002)	*
La-140 (11)	5.8E+000 (2.8E+000 - 1.7E+001)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

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TABLE 3.22
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Scallops, Edible, Raw Mass Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (3)	7.3E+000 (6.5E+000 - 7.8E+000)	*		*	*
Ce-141 (3)	2.4E+000 (2.2E+000 - 2.5E+000)	*		*	*
Cr-51 (3)	1.3E+001 (1.0E+001 - 1.6E+001)	*		*	*
I-131 (3)	6.1E+000 (2.2E+000 - 1.3E+001)	*		*	*
Be-7 (3)	1.2E+001 (9.3E+000 - 1.3E+001)	*		*	*
Ru-103 (3)	1.4E+000 (1.2E+000 - 1.6E+000)	*		*	*
Ba-140 (3)	1.0E+001 (8.0E+000 - 1.4E+001)	*		*	*
Cs-134 (3)	1.2E+000 (8.1E-001 - 1.5E+000)	*		*	*
Ru-106 (3)	1.2E+001 (9.0E+000 - 1.5E+001)	*		*	*
Cs-137 (3)	1.3E+000 (1.1E+000 - 1.6E+000)	*		*	*
Zr-95 (3)	2.1E+000 (2.0E+000 - 2.2E+000)	*		*	*
Nb-95 (3)	1.2E+000 (8.4E-001 - 1.5E+000)	*		*	*
Co-58 (3)	1.6E+000 (1.3E+000 - 1.8E+000)	*		*	*
Mn-54 (3)	1.1E+000 (7.7E-001 - 1.4E+000)	*		*	*

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TABLE 3.22 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Scallops, Edible, Raw Mass Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (3)	1.5E+000 (1.3E+000 - 1.6E+000)	*		*	*
Ac-228 (3)	3.8E+000 (3.6E+000 - 4.0E+000)	*		*	*
Fe-59 (3)	2.8E+000 (2.5E+000 - 2.9E+000)	*		*	*
Zn-65 (3)	3.3E+000 (2.8E+000 - 3.8E+000)	*		*	*
Co-60 (3)	1.2E+000 (1.0E+000 - 1.4E+000)	*		*	*
K-40 (3)	1.1E+001 (1.0E+001 - 1.3E+001)	1.3E+002 (3/3) (1.0E+002 - 1.6E+002)	H02	1.3E+002 (3/3) (1.0E+002 - 1.6E+002)	*
La-140 (3)	3.5E+000 (1.5E+000 - 6.6E+000)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

TABLE 3.23
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

92-03-04

Sea Plant, Wet Mass Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (16)	3.0E+000 (2.2E+000 - 4.0E+000)	*		*	*
Ce-141 (16)	7.2E-001 (5.7E-001 - 9.0E-001)	*		*	*
Cr-51 (16)	3.8E+000 (2.8E+000 - 4.8E+000)	*		*	*
I-131 (16)	5.4E-001 (3.6E-001 - 7.1E-001)	2.2E+000 (2/16) (1.8E+000 - 2.5E+000)	G01	2.5E+000 (1/4) (2.5E+000 - 2.5E+000)	*
Be-7 (16)	4.4E+000 (2.8E+000 - 6.6E+000)	1.1E+001 (4/16) (6.3E+000 - 1.8E+001)	E03	1.4E+001 (2/4) (1.1E+001 - 1.8E+001)	*
Ru-103 (16)	4.7E-001 (3.0E-001 - 6.7E-001)	*		*	*
Ba-140 (16)	1.8E+000 (1.3E+000 - 2.4E+000)	*		*	*
Cs-134 (16)	4.1E-001 (2.4E-001 - 5.5E-001)	*		*	*
Ru-106 (16)	4.3E+000 (2.8E+000 - 5.7E+000)	*		*	*
Cs-137 (16)	5.2E-001 (3.9E-001 - 6.4E-001)	*		*	*
Zr-95 (16)	8.4E-001 (6.1E-001 - 1.2E+000)	*		*	*
Nb-95 (16)	5.0E-001 (3.9E-001 - 7.2E-001)	*		*	*
Co-58 (16)	4.7E-001 (3.4E-001 - 6.5E-001)	*		*	*
Mn-54 (16)	4.9E-001 (2.4E-001 - 8.4E-001)	*		*	*

TABLE 3.23 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Sea Plant, Wet Mass Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (16)	6.6E-001 (4.3E-001 - 1.0E+000)	*		*	*
Ac-228 (16)	2.1E+000 (9.4E-001 - 2.7E+000)	2.6E+000 (1/16) (2.6E+000 - 2.6E+000)	E03	2.6E+000 (1/4) (2.6E+000 - 2.6E+000)	*
Fe-59 (16)	1.2E+000 (9.2E-001 - 1.7E+000)	*		*	*
Zn-65 (16)	1.4E+000 (8.2E-001 - 1.9E+000)	*		*	*
Co-60 (16)	5.8E-001 (3.7E-001 - 7.7E-001)	*		*	*
K-40 (16)	5.0E+000 (0.0E+001 - 7.0E+000)	2.1E+002 (16/16) (1.7E+002 - 2.6E+002)	H03	2.2E+002 (6/6) (1.7E+002 - 2.6E+002)	*
La-140 (16)	5.0E-001 (2.0E-001 - 1.0E+000)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

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TABLE 3.24
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Vegetation Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ce-144 (15)	4.2E+001 (2.1E+001 - 7.2E+001)	*		*	*
Ce-141 (15)	9.6E+000 (4.0E+000 - 1.8E+001)	*		*	*
Cr-51 (15)	5.8E+001 (2.7E+001 - 1.0E+002)	*		*	*
I-131 (15)	8.3E+000 (3.8E+000 - 1.6E+001)	*		*	*
Be-7 (15)	5.7E+001 (3.1E+001 - 9.4E+001)	2.6E+002 (15/15) (8.4E+001 - 5.4E+002)	111	4.0E+002 (3/3) (3.0E+002 - 5.4E+002)	*
Ru-103 (15)	6.4E+000 (3.3E+000 - 1.2E+001)	*		*	*
Ba-140 (15)	2.6E+001 (7.1E+000 - 4.5E+001)	*		*	*
Cs-134 (15)	6.1E+000 (3.1E+000 - 9.8E+000)	*		*	*
Ru-106 (15)	5.6E+001 (2.6E+001 - 1.1E+002)	*		*	*
Cs-137 (15)	7.3E+000 (3.7E+000 - 1.4E+001)	4.2E+001 (13/15) (1.5E+001 - 6.6E+001)	100	6.4E+001 (2/3) (6.3E+001 - 6.5E+001)	*
Zr-95 (15)	1.1E+001 (6.7E+000 - 1.9E+001)	*		*	*
Nb-95 (15)	6.0E+000 (2.5E+000 - 1.3E+001)	*		*	*
Co-58 (15)	6.8E+000 (2.9E+000 - 1.3E+001)	*		*	*
Mn-54 (15)	6.0E+000 (1.9E+000 - 1.1E+001)	*		*	*

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TABLE 3.24 (Cont'd)
Point Lepreau Generating Station
Environmental Radiation Monitoring
Summary of Analyses for the Period
91-01-01 to 91-12-31

Vegetation Bq/kg

Analysis Type (Total Number)	Critical Level Mean (Range)	Indicator Stations Mean (F) (Range)	Highest Indicator Station Location	Highest Indicator Station Mean (F) (Range)	Reference Station Mean (F) (Range)
Ag-110m (15)	7.3E+000 (2.3E+000 - 1.3E+001)	*		*	*
Ac-228 (15)	2.5E+001 (1.4E+001 - 4.4E+001)	*		*	*
Fe-59 (15)	1.2E+001 (5.0E+000 - 2.4E+001)	*		*	*
Zn-65 (15)	1.3E+001 (5.1E+000 - 2.3E+001)	*		*	*
Co-60 (15)	6.6E+000 (1.7E+000 - 1.2E+001)	*		*	*
K-40 (15)	6.7E+001 (0.0E+001 - 2.0E+002)	2.3E+002 (10/15) (1.1E+002 - 4.2E+002)	100	2.5E+002 (2/3) (2.1E+002 - 2.9E+002)	*
La-140 (15)	8.3E+000 (2.6E+000 - 2.0E+001)	*		*	*

* : The activity is less than or equal to the Critical Level (99% Confidence Level).

F : Number of analyses greater than the Critical Level/Total number of analyses.

4.0 DISCUSSION OF ENVIRONMENTAL DATA

4.1 Airborne Particulates (filters) - Table 3.01

There were no detectable airborne particulate radionuclides that could be attributed to the operation of PLGS.

Gross alpha and gross beta measurements indicate naturally occurring radionuclides in the environment, cosmogenic radionuclides (Be-7), and any contribution from man-made sources. Plots of the gross alpha and gross beta data from 1976 to 1991 at Dipper Harbour, about 4 km from the PLGS stack in the predominant downwind direction, are presented in Figure 4.1. The baseline data show the naturally occurring levels of radioactivity in the area. The peaks on the plots correspond to fallout from various atmospheric bomb tests in the early 60s; from the Chinese bomb test in October of 1980 (fallout occurred in 1981 in N.B.); and from the Chernobyl accident in April 1986 which, by comparison, released only about 1% of the total radioactivity released in all of the US atmospheric bomb tests. Potassium-40, a naturally occurring radionuclide, detected on a few filters indicates a pick up of airborne dust or salt spray from the sea.

4.2 Airborne Radioiodines - Table 3.02

All I-131 levels were below the Lower Limit of Detection.

4.3 Airborne Tritium - Tables 3.03A, 3.03B and 3.03C

Table 3.03A is the summary table of 1991 tritium data; Table 3.03B gives details of 1991 tritium results by location and Table 3.03C is a summary of tritium data obtained since this program was started in 1976.

In general, tritium levels in air and water have fallen in the northern hemisphere since the cessation of atmospheric weapons tests, despite the small additions made from routine releases from nuclear power plants.

Tritium was detected in most air monitoring stations on the Point Lepreau peninsula (75 of 84 samples) in 1991 but, for only the second time in 12 years, was not detected in any of the 12 samples at the Reference location. Calculation of the annual average dispersion factor for stack emissions for this and previous years, based upon the data for tritium, indicate good comparison with the value at 1 km (2.2E+7 s/m^3) used in the DEL licensing document (1). Results since 1984 are presented in Tables 4.01 and 4.02.

(1) "Derived Emission Limits for Radionuclides in Gaseous and Liquid Effluents." New Brunswick Electric Power Commission Report NBEPC-HP-76-1, 1976.

TABLE 4.01

AVERAGE ATMOSPHERIC DISPERSION FACTOR
FOR EACH AIR MONITORING LOCATION (1)

Locn.	E01 Maces Bay	F01 Welch Cove	G02 Light-house	H04 Info. Centre	I01 SRWMF	K02 Pump-house	L04 Stores	N01 Dipper Hrbr.
km from stack	4.5	1.5	1.0	0.8	1.0	0.2	0.6	3.8
Year			Dispersion Factors: s/m³					
1984	8E-8	8E-8	2E-7	5E-7	7E-7*	5E-7		8E-8
1985	2E-8	4E-8	9E-8	3E-7	2E-7	3E-7		5E-8
1986	3E-8	5E-8	1E-7	3E-7	2E-7	5E-7		6E-8
1987	4E-8	5E-8	2E-7	5E-7	4E-7	7E-7		2E-7
1988	3E-8	7E-8	1E-7	4E-7	3E-7	#	2E-7	9E-8
1989	2E-8	4E-8	8E-8	4E-7	3E-7	#	2E-7	8E-8
1990	2E-8	3E-8	8E-8	3E-7	2E-7	#	1E-7	8E-8
1991	2E-8	3E-8	5E-8	3E-7	3E-7	#	7E-8	7E-8

(1) Excluding the Reference location A01R.

* This value includes a second source term, i.e., contaminated containers temporarily located in this facility in 1984, and is ignored in the calculation of the normalised mean dispersion factor. In the calculation of the means at each location, all of the "less than" data were taken as equal to the "less than" value and thus are likely to over-estimate the true value.

no longer in use. This monitoring station was relocated to L04 - the Construction Stores Warehouse - in the spring of 1988.

TABLE 4.02

NORMALIZED MEAN DISPERSION FACTOR
AT 1 km FOR ALL LOCATIONS

Year	s/m³
1984	2E-07
1985	1E-07
1986	1E-07
1987	3E-07
1988	2E-07
1989	2E-07
1990	1E-07
1991	1E-07
Average over 8 years	2E-07

To derive a normalised mean dispersion factor at 1 km from the stack for all locations, each dispersion factor value is corrected to 1 km. This is accomplished by tracing back between dispersion curves on the graph of "Weighted Mean Dilution Factor versus Distance from the Point of Continuous Emission" (reproduced in the DEL licensing document referred to previously).

4.4 Airborne Carbon-14 - Tables 3.04A and 3.04B

Carbon-14 collection and analysis was started in 1983. Results for 1991 are summarized in Table 3.04A. Individual analyses are given in Table 3.04B.

There were 2 detectable values for C-14 out of 24 samples at the indicator locations in 1991.

4.5 Environmental Gamma Radiation

4.5.1 TLD Data - Tables 3.05A, 3.05B and 3.05C

Background radiation levels on the Lepreau Peninsula during 1991, as measured by TLD (including cosmic and soil gamma radiation but not alpha radiation from radium and thorium daughters) are comparable with those measured before 1982.

A summary of data obtained at each location since 1987 is presented in Table 3.05B, including the Dry Fuel Storage location. Dosimeters are in place around this facility to measure drop-off of radiation with distance. Results are presented in Table 3.05C.

TLD values (in microsievert) are presented in Table 4.03 for:

1. Selected residential locations around the Lepreau peninsula close to PLGS

2. The Solid Radioactive Waste Monitoring Facility (SRWMF - average of 12 locations) and

3. The Dry Fuel Storage facility (DFS - average of 5 locations in 1990 and the average of 12 locations in 1991.

TABLE 4.03

AVERAGE BACKGROUND RADIATION (microsievert/year)

Year	Dipper Harbour	Welch Cove	Maces Bay	SRWMF	DFS
1978	780	730	600	----	---
1979	1040	780	850	----	---
1980	660	960	670	845	---
1981	680	790	620	935	---
1982	890	810	890	940	---
1983	850	650	740	941	---
1984	800	600	680	942	---
1985	920	690	800	1072	---
1986	880	680	840	1032	---
1987	930	690	790	1028	---
1988	980	720	880	1112	---
1989	940	640	800	1050	---
1990	820	570	690	940	494*
1991	790	580	730	948	766+

SRWMF is Solid Radioactive Waste Management Facility.
DFS is Dry Fuel Storage.
* This figure, which appears to be unusually low, is an annual estimate derived from measurements taken only for the last quarter of 1990 on trees at the perimeter of this general area.
+ This figure is taken both from TLDs mounted on trees in this area before construction was completed, and others on the newly constructed fence around this facility. All 12 locations have at least two measurements contributing to the average while five locations have measurements spanning the entire year.

Increasing average values at the boundary of the SRWMF might be expected as the facility is filled. Although an upward trend is evident up to 1988, falling off again in 1990 and 1991, the values are still within the anticipated range of year to year natural background variation. They are similar to the values seen before the facility came into use and thus do not reflect any obvious effect from radioactive waste materials stored there.

In the Autumn of 1991, 10 of the dry storage cannisters were filled with spent fuel from PLGS and sealed. Field radiation measurements within the compound could not detect any change from the background measurements taken at this location before the cannisters were loaded. Within about 5 metres of the cannisters the radiation field was detectable at between 1 and 2 microsieverts per hour.

TLDs are located on the fence surrounding the area (Table 3.05B), and other TLDs are used to indicate drop-off of radiation with distance away from the fence (Table 3.05C). At the present time there is nothing to indicate that the storage facility is contributing in any way to ambient radiation levels in this location.

Radiation drop-off measurements (Table 3.05C) with increasing distance away from the fence of the Dry Fuel storage location show minor differences between measurements at the fence and measurements about 100 metres away. The 'A' direction covers drop-off to the North away from the perimeter fence while the 'B' direction covers drop-off to the West away from the perimeter. All measurements are fairly typical of background radiation in this area before the cannisters were brought into use.

The variation in natural background radiation at any individual location covers a range of about 300 microsieverts from year to year. No significant trending is obvious at any location.

4.5.2 Gamma Survey Measurements Table 3.06

Environmental gamma survey measurements are made in the inter-tidal zone on beaches in the Point Lepreau area and at the Reference location Q01R, 28 km to the ENE. Although TLDs are preferred in measuring such exposures since they span the entire year and provide integrated measurements, they are not suitable for use in these locations. Radiation levels in 1991 are consistent with those measured prior to station start-up in 1982.

4.6 Sediments - Tables 3.07A and 3.07B

Sediments collected from beaches and tidal mud flats contain radioactivity, both from naturally occurring radionuclides (K-40) and from the diminishing levels of Cs-137 fallout from bomb tests since the 1950s. A small additional Cs-137 component from Chernobyl was added to this reservoir in 1986. Both Ac-228 (a radioactive daughter of naturally occurring Th-232), and Be-7 (of cosmogenic origin) commonly occur in sediments. A summary of the Cs-137 levels in sediments over the last fourteen years is given in Table 3.07B.

4.7 Soil

No soil samples were analyzed in 1991.

4.8 Well Water - Table 3.08

No gamma emitting radionuclides other than those occurring in nature from radon daughters were detected in water samples during this sampling period or at any time since measurements were started.

Tritium occurred in six of twenty-two well waters (average 16 Bq/L, covering the range from 12 to 24 Bq/L), at just above the Critical Level (about 12 Bq/L). The tritium measurements were made after samples had been allowed to sit for up to two weeks to avoid being swamped by interference from the relatively abundant radon daughters. The tritium indicates probable surface rainwater run-off contribution to some of the wells. The 1987 Guidelines for Canadian Drinking Water Quality recommend 40 000 Bq/L as the maximum acceptable continuous concentration for tritium in drinking water, i.e., tritium in these well waters is at least two thousand times less than that stipulated in the guidelines which themselves provide a significant margin of safety.

Measurements of gross alpha and beta in well waters are made about 2 weeks after sample collection to allow for decay and disappearance of radon daughters in order to minimize interference with the analyses. Natural radon and radon daughters tend to occur in high concentrations in many New Brunswick well waters. As they occur almost exclusively in nature, they are outside of the scope and the intent of the drinking water guidelines.

4.9 Bore Hole Water (SRWMF and DFS) - Tables 3.09 and 3.10

Waters from Bore Holes on the SRWMF site and the dry fuel storage (DFS) site are analyzed for radionuclides. Tritium, as tritiated water, was detected in all 11 SRWMF samples at an average concentration of 100 Bq/L, ranging from 38 to 180 Bq/L. The SRWMF is located on high ground which receives no water flow. At the DFS location, tritium was detected in 25 of 28 samples at an average concentration of 45 Bq/L, covering the range from 14 to 100 Bq/L. All near-surface groundwater in the area is from rainfall which may contain up to this concentration of tritium. No other radionuclides attributable to the operation of PLGS were detected.

4.10 Parshall Flume (SRWMF and DFS) Tables 3.11 and 3.12

Rainwater at the SRWMF and the DFS facilities is collected in specially constructed drainage channels (flumes). Samples are collected and analyzed on a weekly basis. There is little or no flow into or out of these collection locations during the winter months and values for tritium, the only detected radionuclide from PLGS, tend to vary little from one week to the next except after heavy rain. Tritium was detected in all of the Parshall Flume water analyses, ranging from 74 to 1000 Bq/L, with a mean value of

370 Bq/L. At the Dry Fuel storage location, tritium was detected in all samples covering the range from 23 to 170 Bq/L, averaging 66 Bq/L. The tritium is due to washout of atmospheric tritium in rainfall, fog and snow at this location. No gamma emitting radionuclides, except for those that occur naturally, were detected in any of the samples.

4.11 Lagoon Water - Table 3.13

Most of the inactive liquid drainage from PLGS empties into drainage lagoons on the site. Tritium was detected in all 34 lagoon water samples analyzed, ranging from 26 to 35 000 Bq/L with an average of 6300 Bq/L. With a discharge rate in this pathway of about 100 m^3/day, contribution to the environment is about 5000 times less than emissions in the active liquid effluent pathway. The liquids from these lagoons are drained to the Condenser Cooling Water (CCW) duct, hence the pathway to the environment is the same as for other liquid effluents.

4.12 Sea Water - Table 3.14

Naturally occurring daughters of radon and K-40 were the only gamma emitting radionuclides found in sea water during the sampling period. Tritium was detected in 1 of 12 samples (22 Bq/L). The lower limit of detection for tritium in sea water averages about 12 Bq/L. Calculations show that the long term average concentration of tritium in sea water due to releases from PLGS in the liquid effluent pathway, in 1991, was about 10 Bq/L at the outfall. This calculation takes into account the total tritium released over the year, the flow rate of the condenser cooling water (24 m^3/s) and tidal mixing. Because releases are not continuous however, the concentrations of tritium released in the cooling water flow at the time of liquid effluent pump-out may reach several hundred Bq/L at the outfall discharge. Depending upon the time of collection of sea water samples relative to the pumpout time, tritium may occasionally be detectable for a short time at sample collection locations close to the station until dilution occurs through tidal mixing.

4.13 Milk - Table 3.15

Milk from a commercial dairy and milk samples from herds in the south of the province are analyzed on a regular basis as available. There are no commercial herds or individual cows producing milk in the Point Lepreau area. The closest herds to PLGS are in St. Andrews (55 km distant) and Fredericton Junction (70 km distant), and the milks from these locations are analyzed. Cesium-137 was detected in three of twenty samples at an average of 0.1 Bq/L. The cesium-137 originated from fallout from bomb tests in the 50s and 60s and more recently from the accident at Chernobyl in 1986. Natural radionuclides (including K-40 at about 50 Bq/L, and daughters of uranium and thorium) also occur. As airborne emissions from PLGS are monitored continuously, and were insignificant all year, neither tritium nor gamma emitting radionuclides attributable

to the operation of PLGS would be expected to be detected in these milks.

4.14 Seafood - Tables 3.16 to 3.22

All of the seafoods analyzed in the environmental program contain naturally occurring radionuclides, e.g., K-40. Some, such as clams and scallops may contain detectable quantities of natural Ac-228. No contributions from the operation of Point Lepreau were detected even though several of the samples (consisting of crabs, scallops and lobster) were collected at the cooling water outflow from PLGS. Dulse, an edible seaweed, is included in this category as it is a popular delicacy and snack food in this region.

The inshore fishery suffers some disruption each year due to restrictions placed upon the harvesting of shellfish either for conservation of stocks or because of bacterial contamination, algal-blooms, or other natural cycles. This restricts the availability of samples for analysis.

4.15 Sea Plants - Table 3.23

Seaweeds other than dulse are also analyzed. Various species of seaweed (for example, Ascophylum) are readily available from the rocks on the Point Lepreau peninsula close to the outfall and are collected from time to time. In 1991, two of sixteen seaweed samples contained traces of iodine-131, between 1.8 and 2.5 Bq/kg. Emissions of iodine-131 were slightly elevated this year due to the occurrence of several defective fuel bundles.

4.16 Vegetation (Lichen) - Table 3.24

Different species of lichen and moss concentrate a wide range of radionuclides, both natural (Be-7) and man-made, and are sensitive indicators of radionuclides in the environment. Cesium-137 is detected from previous bomb tests and Chernobyl fallout. There was no detectable contribution from the operation of PLGS in 1991.

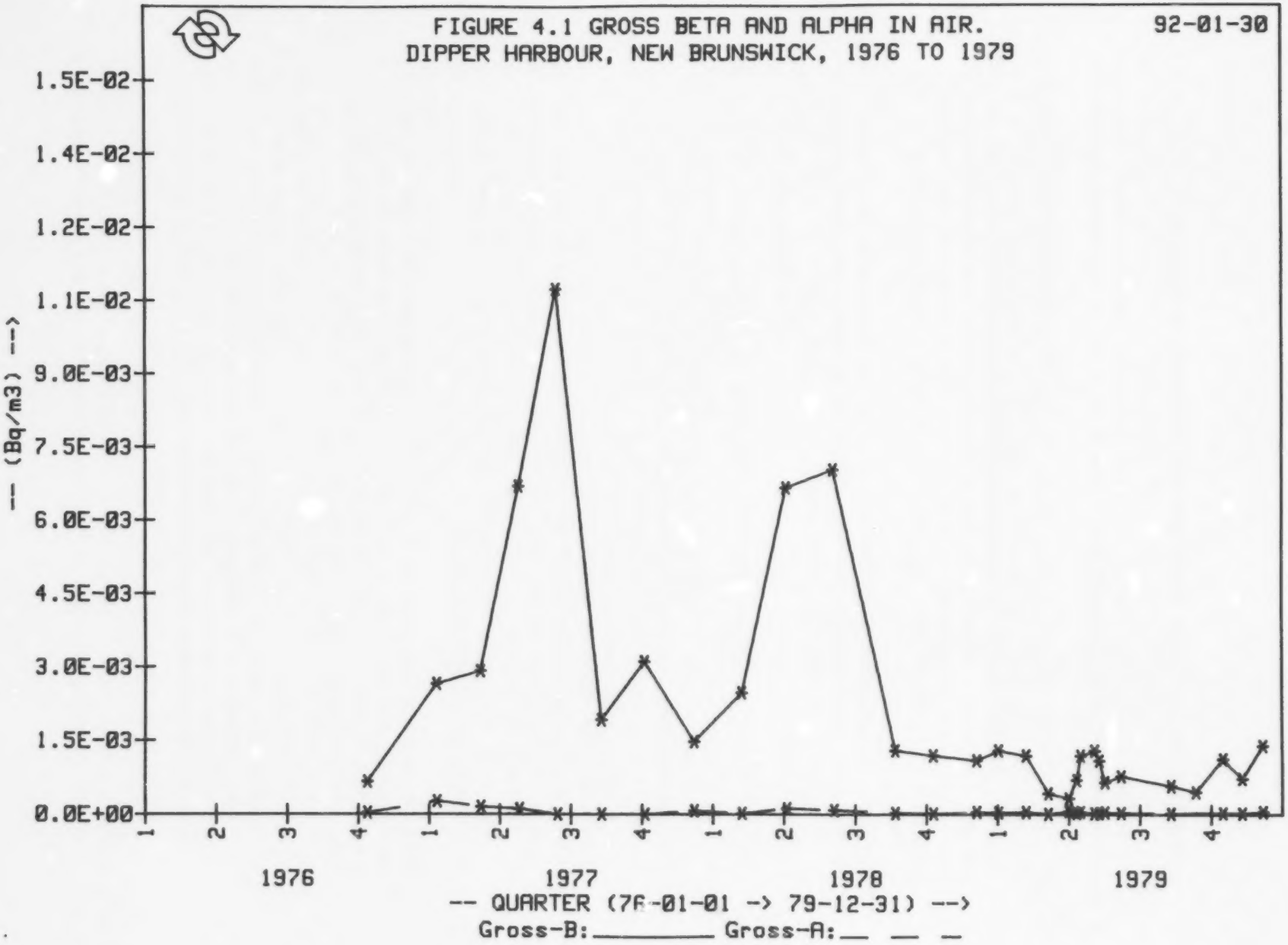


FIGURE 4.1 GROSS BETA AND ALPHA IN AIR.
DIPPER HARBOUR, NEW BRUNSWICK, 1976 TO 1979
92-01-30
1.5E-02
1.4E-02
1.2E-02
1.1E-02
9.0E-03
7.5E-03
6.0E-03
4.5E-03
3.0E-03
1.5E-03
0.0E+00
-- (Bq/m3) -->
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
1976
1977
1978
1979
-- QUARTER (76-01-01 -> 79-12-31) -->
Gross-B:_____ Gross-A:__ __ __

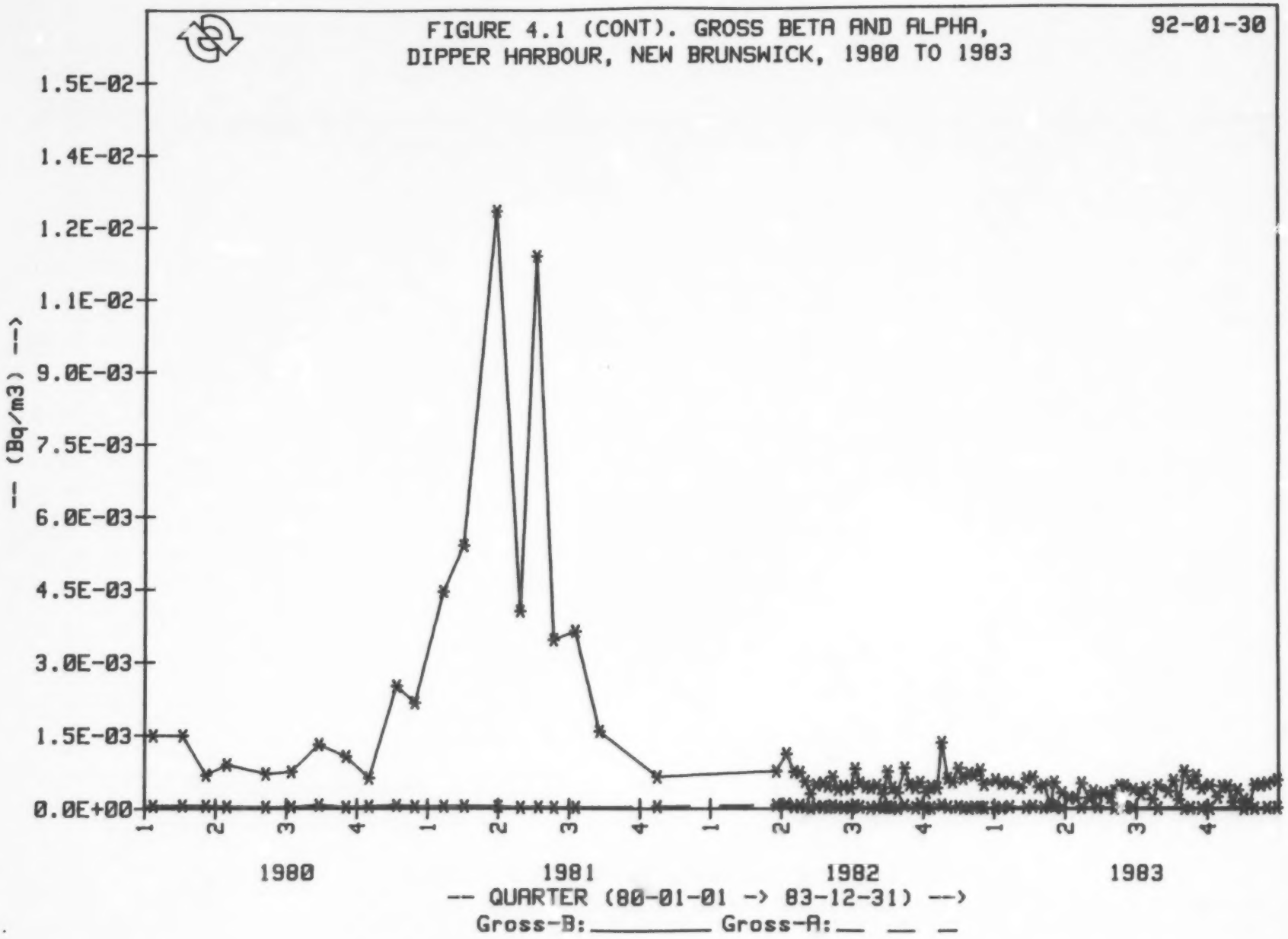


FIGURE 4.1 (CONT). GROSS BETA AND ALPHA,
DIPPER HARBOUR, NEW BRUNSWICK, 1980 TO 1983
92-01-30
1.5E-02
1.4E-02
1.2E-02
1.1E-02
9.0E-03
7.5E-03
6.0E-03
4.5E-03
3.0E-03
1.5E-03
0.0E+00
-- (Bq/m3) -->
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
1980
1981
1982
1983
-- QUARTER (80-01-01 -> 83-12-31) -->
Gross-B:_____ Gross-A:__ __ __

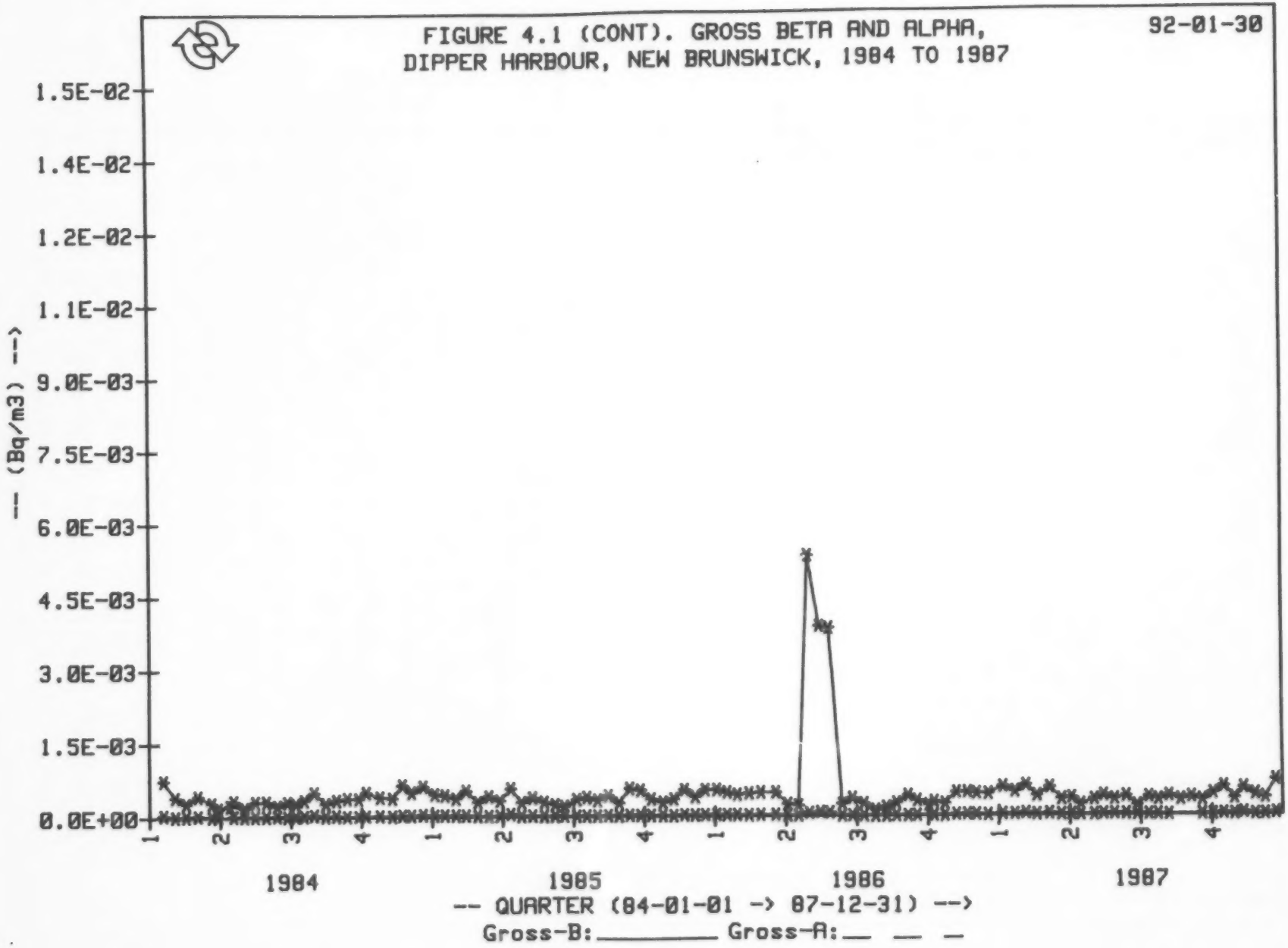


FIGURE 4.1 (CONT). GROSS BETA AND ALPHA,
DIPPER HARBOUR, NEW BRUNSWICK, 1984 TO 1987
92-01-30
1.5E-02
1.4E-02
1.2E-02
1.1E-02
9.0E-03
7.5E-03
6.0E-03
4.5E-03
3.0E-03
1.5E-03
0.0E+00
-- (Bq/m3) -->
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
1984
1985
1986
1987
-- QUARTER (84-01-01 -> 87-12-31) -->
Gross-B:_____ Gross-A:__ __ _

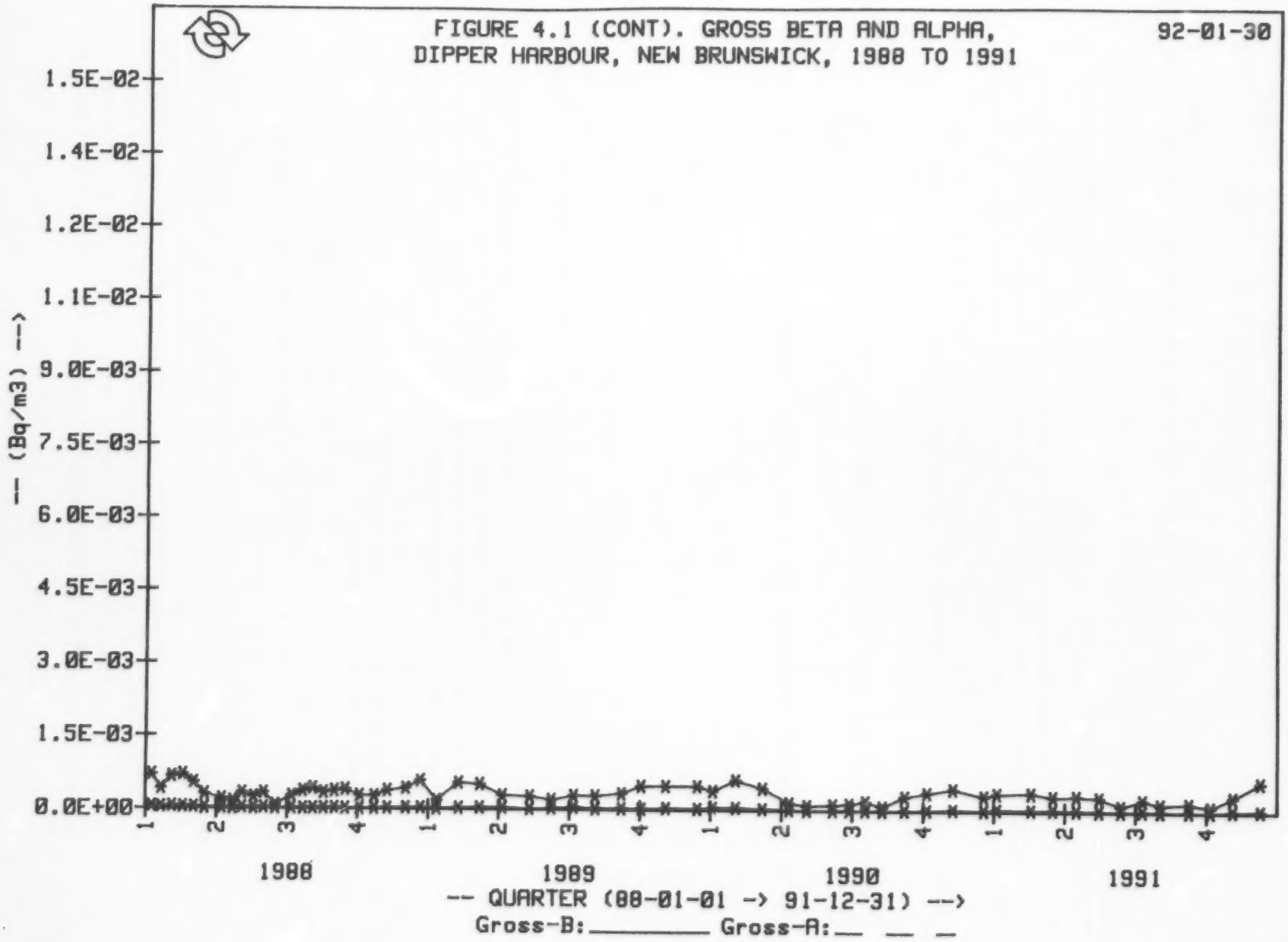


FIGURE 4.1 (CONT). GROSS BETA AND ALPHA,
DIPPER HARBOUR, NEW BRUNSWICK, 1988 TO 1991
92-01-30
1.5E-02
1.4E-02
1.2E-02
1.1E-02
9.0E-03
7.5E-03
6.0E-03
4.5E-03
3.0E-03
1.5E-03
0.0E+00
-- (Bq/m3) -->
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
1988
1989
1990
1991
-- QUARTER (88-01-01 -> 91-12-31) -->
Gross-B:_____ Gross-A:__ __ __

5.0 QUALITY CONTROL AND QUALITY ASSURANCE

5.1 Introduction

Internal Quality Control checks and performance of calibrations traceable to U.S. or Canadian National Standards are routine for all analytical techniques in the Health Physics Environmental Laboratory. In addition, Quality Assurance programs (Table 5.01) regularly test the accuracy of the laboratory analytical procedures by submitting a variety of samples for blind analysis. Approximately 10% or more of the laboratory time is spent analyzing such samples.

5.2 Quality Control

The daily Quality Control (QC) evaluations in the laboratory cover the following instruments:

1. Intrinsic Ge Gamma Spectrometer
2. Beckman Liquid Scintillation Counter
3. Tennelec LB-5100 Gross Alpha/Beta Detector
4. Panasonic UD-710A TLD Reader

In the QC program, the operating parameters of each of the major instruments are evaluated at the start of each working day. This ensures that they are consistent from day to day and remain free from significant drift or random variation that could influence the analyses. A compilation of the statistical fluctuations is maintained day by day to show the upper and lower limits usually seen over the year and from one year to the next. From these data, upper and lower flag limits are set in the QC programs. If any of the equipment exceeds these limits, then it is usually not used in the laboratory operations until the problem has been resolved.

5.2.1 Intrinsic Ge Gamma Spectrometer

A daily check of seven system parameters is performed for the germanium gamma spectrometry system. The results are processed by a computer program which generates QC plots and performs statistical tests to detect out-of-range values. The program processes the results from the analysis of a Eu-152 point source which is analyzed at the beginning of each working day. A 200 000 s background count (over the weekend) is made weekly to ensure the absence of contamination in the sample chamber. The total counts in eight separate regions of the background spectrum are evaluated by the QC

program and out-of-range values are flagged. Because of the precautions adopted in handling all samples analyzed in the laboratory, no contamination has been found to date.

Calibration

Complete efficiency calibrations on the gamma spectrometry systems are performed on an annual basis, usually at the beginning of each year, for each of the counting geometries. This is accomplished by use of an Amersham mixed nuclide standard traceable to the U.S. National Institute of Standards and Technology (NIST).

5.2.2 Beckman Liquid Scintillation Counter

A range of sealed tritium, C-14 and background standards traceable to U.S. National Standards is analyzed daily.

5.2.3 Tennelec LB-5100 Gross Alpha/Beta Detector

Planchet standards of Am-241 and Sr-Y-90 are analyzed daily. Alpha and Beta discrimination allows the simultaneous analysis of alpha and beta emissions on all samples analyzed. Planchet and filter backgrounds are included in the QC checks.

5.2.4 Panasonic UD-710A TLD Reader

A set of 16 randomly chosen TLDs is exposed daily on a depleted uranium slab for 30 minutes. Readout of these TLDs monitors the Reader functions.

5.3 External Intercomparison Programs

In addition to these in-house QC checks, the Health Physics Environmental Laboratory participates in intercomparisons with other laboratories when appropriate programs are available. This allows independent verification of analytical performance. Table 5.01 lists the intercomparison programs in which NB Power takes part.

TABLE 5.01

QUALITY ASSURANCE PROGRAMS INVOLVING OTHER AGENCIES

Sample Type	Analysis	Frequency	Agency
Air Filter	Gross Alpha	6 months	US EPA*
	Gross Beta		
	Cs-137		
	Sr-90		
Environmental Gamma rad.	TLD	Approx. every 2 years	US DOE*
Milk	Gamma	6 Months	US EPA
Fresh Water	Gross Alpha	4 months	US EPA
	Gross Beta	4 months	
	Tritium	4 months	
	Gamma	4 months	
	Sr-89,90	4 months	
	I-131	6 months	
Laboratory performance evaluation	Gross Alpha	6 months	US EPA
	Gross Beta	6 months	
	Gamma	6 months	
	Sr-89,90	6 months	

* EPA U.S. Environmental Protection Agency.
DOE U.S. Department of Energy.

5.4 Results of Intercomparison programs

Details of performance in the laboratory intercomparisons are given in Tables 5.02 to 5.09 following. The order of the QA data is as follows:

Table 5.02	Comparison of EPA - All users and NB Power Performance.
5.03	Laboratory Performance Evaluation.
5.04	EPA Air Filter analyses.
5.05	EPA Gross alpha/beta in Water.
5.06	EPA Gamma in Water.
5.07	EPA Sr-89, Sr-90 in water.
5.08	EPA Radionuclides in Milk.
5.09	EPA tritium in water.

Each table (except Table 5.02), contains the known results given by the QA agent, the average obtained by all participants, and the results obtained by the Health Physics Environmental Monitoring Laboratory of NB Power. The quoted uncertainties are at the 95% confidence level unless indicated otherwise.

5.5 Discussion of QA results

The QA results for 1991 show that the NB Power environmental radiation monitoring laboratory provided accurate and precise information on the test samples, well within the statistical requirements of the testing program.

Note that the units used in the reporting of the EPA QA results are in picocuries and not becquerels. One picocurie (pCi) is 37 millibecquerels (mBq). The criterion for acceptable performance in the EPA tests is that the participant's results shall be within 3 standard deviations of the known value. However, analyses which are consistently close to this limit indicate that improvements should be attempted.

TABLE 5.02 92-03-04
Point Lepreau Generating Station
Environmental Radiation Monitoring
Quality Assurance Program
91-01-01 to 91-12-31

Comparison of EPA, All Participants and NB Power

Analysis	Table No.	Sample Date	Ratio of Results NB Power/EPA	+- 2 sigma range * All Participants
BETA	5.03	91-04-16	1.02	0.7 - 1.2
	5.03	91-10-22	0.94	0.6 - 1.1
	5.04	91-03-29	1.06	0.8 - 1.3
	5.04	91-08-30	1.07	0.8 - 1.2
	5.05	91-01-25	1.08	0.7 - 1.9
	5.05	91-05-17	0.94	0.6 - 1.3
	5.05	91-09-20	0.99	0.6 - 1.4
Cs-137	5.03	91-04-16	1.01	0.8 - 1.2
	5.03	91-10-22	1.06	0.8 - 1.4
	5.04	91-03-29	1.13	0.7 - 1.5
	5.04	91-08-30	1.10	0.7 - 1.4
	5.06	91-02-08	1.05	0.7 - 1.5
	5.06	91-06-07	1.12	0.8 - 1.4
	5.06	91-10-04	1.04	0.7 - 1.4
	5.08	91-04-26	1.00	0.9 - 1.2
	5.08	91-09-27	1.01	0.9 - 1.2
H-3	5.09	91-02-22	0.85	0.9 - 1.2
	5.09	91-06-21	0.89	0.8 - 1.1
	5.09	91-10-18	0.97	0.8 - 1.3
Sr-89	5.03	91-04-16	0.82	0.5 - 1.4
	5.03	91-10-22	1.05	0.5 - 1.5
	5.07	91-01-11	0.88	0.4 - 1.7
	5.07	91-05-10	0.93	0.5 - 1.4
	5.07	91-09-13	1.31	0.6 - 1.4
Sr-90	5.03	91-04-16	0.93	0.7 - 1.2
	5.03	91-10-22	1.04	0.6 - 1.4
	5.04	91-03-29	1.18	0.7 - 1.2
	5.04	91-08-30	1.02	0.7 - 1.2
	5.07	91-01-11	1.06	0.6 - 1.4
	5.07	91-05-10	0.95	0.7 - 1.2
	5.07	91-09-13	1.09	0.8 - 1.2

* : Excluding those results significantly different from the population mean.

92-03-04

TABLE 5.03
Point Lepreau Generating Station
Environmental Radiation Monitoring
Quality Assurance Program
91-01-01 to 91-12-31

EPA Lab. Performance Evaluation pCi/L +- 2 sigma

Analysis	Sample Date	EPA	* All Participants	NB Power	NB Power/EPA
ALPHA	91-04-16	54 +- 20	50 +- 23	55 +- 3	1.02
	91-10-22	82 +- 30	76 +- 37	82 +- 4	1.00
BETA	91-04-16	115 +- 24	109 +- 28	118 +- 4	1.02
	91-10-22	65 +- 14	56 +- 15	61 +- 2	0.94
Co-60	91-10-22	20 +- 7	20 +- 4	19 +- 2	0.97
Cs-134	91-04-16	24 +- 7	23 +- 4	22 +- 2	0.92
	91-10-22	10 +- 7	10 +- 2	9 +- 1	0.88
Cs-137	91-04-16	25 +- 7	25 +- 5	25 +- 2	1.01
	91-10-22	11 +- 7	12 +- 3	12 +- 1	1.06
Sr-89	91-04-16	28 +- 7	26 +- 13	23 +- 1	0.82
	91-10-22	10 +- 7	10 +- 5	11 +- 1	1.05
Sr-90	91-04-16	26 +- 7	24 +- 7	24 +- 1	0.93
	91-10-22	10 +- 7	10 +- 4	10 +- 1	1.04

* : Excluding those results significantly different from the population mean.

TABLE 5.04 92-03-04
Point Lepreau Generating Station
Environmental Radiation Monitoring
Quality Assurance Program
91-01-01 to 91-12-31

EPA Alpha,Beta,Cs,Sr in Air Filter pCi +- 2 sigma

Analysis	Sample Date	EPA	* All Participants	NB Power	NB Power/EPA
ALPHA	91-03-29	25 +- 8	30 +- 12	30 +- 1	1.20
	91-08-30	25 +- 8	28 +- 10	29 +- 1	1.17
BETA	91-03-29	124 +- 8	130 +- 27	132 +- 1	1.06
	91-08-30	92 +- 14	96 +- 18	98 +- 1	1.07
Cs-137	91-03-29	40 +- 7	45 +- 15	45 +- 3	1.13
	91-08-30	30 +- 7	32 +- 11	33 +- 3	1.10
Sr-90	91-03-29	40 +- 7	39 +- 10	47 +- 1	1.18
	91-08-30	30 +- 7	29 +- 8	31 +- 1	1.02

* : Excluding those results significantly different from the population mean.

92-03-04

TABLE 5.05
Point Lepreau Generating Station
Environmental Radiation Monitoring
Quality Assurance Program
91-01-01 to 91-12-31

EPA Gross Alpha/Beta in Water pCi/L +- 2 sigma

Analysis	Sample Date	EPA	* All Participants	NB Power	NB Power/EPA
ALPHA	91-01-25	5 +- 7	6 +- 4	6 +- 1	1.16
	91-05-17	24 +- 8	21 +- 13	25 +- 2	1.03
	91-09-20	10 +- 7	10 +- 6	10 +- 1	1.04
BETA	91-01-25	5 +- 7	6 +- 3	5 +- 1	1.08
	91-05-17	46 +- 7	45 +- 15	43 +- 2	0.94
	91-09-20	20 +- 7	20 +- 7	20 +- 1	0.99

* : Excluding those results significantly different from the population mean.

TABLE 5.06 92-03-04
Point Lepreau Generating Station
Environmental Radiation Monitoring
Quality Assurance Program
91-01-01 to 91-12-31

EPA Gamma in Water pCi/L +- 2 sigma

Analysis	Sample Date	EPA	* All Participants	NB Power	NB Power/EPA
Ba-133	91-02-08	75 +- 11	74 +- 12	70 +- 4	0.93
	91-06-07	62 +- 8	61 +- 11	61 +- 4	0.98
	91-10-04	98 +- 14	96 +- 15	93 +- 5	0.95
Co-60	91-02-08	40 +- 7	40 +- 6	40 +- 3	1.00
	91-06-07	10 +- 7	11 +- 5	11 +- 1	1.07
	91-10-04	29 +- 7	30 +- 6	30 +- 3	1.03
Cs-134	91-02-08	8 +- 7	8 +- 4	6 +- 1	0.80
	91-06-07	15 +- 7	14 +- 4	13 +- 1	0.85
	91-10-04	10 +- 7	10 +- 4	9 +- 1	0.94
Cs-137	91-02-08	8 +- 7	9 +- 3	8 +- 1	1.05
	91-06-07	14 +- 7	15 +- 4	16 +- 2	1.12
	91-10-04	10 +- 7	11 +- 4	10 +- 1	1.04
I-131	91-02-15	75 +- 11	77 +- 12	72 +- 5	0.96
	91-08-09	20 +- 8	21 +- 6	20 +- 3	1.01
Ru-106	91-02-08	186 +- 27	192 +- 40	173 +- 17	0.93
	91-06-07	149 +- 21	141 +- 28	130 +- 14	0.87
	91-10-04	199 +- 28	194 +- 42	182 +- 18	0.91
Zn-65	91-02-08	149 +- 21	150 +- 21	144 +- 10	0.97
	91-06-07	108 +- 16	110 +- 16	106 +- 8	0.98
	91-10-04	73 +- 7	75 +- 13	70 +- 6	0.96

* : Excluding those results significantly different from the population mean.

92-03-04

TABLE 5.07
Point Lepreau Generating Station
Environmental Radiation Monitoring
Quality Assurance Program
91-01-01 to 91-12-31

EPA Sr-89,90 in Water pCi/L +- 2 sigma

Analysis	Sample Date	EPA	* All Participants	NB Power	NB Power/EPA
Sr-89	91-01-11	5 +- 7	5 +- 3	4 +- 0	0.88
	91-05-10	39 +- 7	37 +- 17	36 +- 1	0.93
	91-09-13	49 +- 7	50 +- 18	64 +- 2	1.31
Sr-90	91-01-11	5 +- 7	5 +- 2	5 +- 0	1.06
	91-05-10	24 +- 7	24 +- 6	23 +- 1	0.95
	91-09-13	25 +- 7	25 +- 6	27 +- 1	1.09

* : Excluding those results significantly different from the population mean.

TABLE 5.08
Point Lepreau Generating Station
Environmental Radiation Monitoring
Quality Assurance Program
91-01-01 to 91-12-31

92-03-04

EPA Radionuclides in Milk pCi/L +- 2 sigma

Analysis	Sample Date	EPA	* All Participants	NB Power	NB Power/EPA
Cs-137	91-04-26	49 +- 7	51 +- 7	49 +- 3	1.00
	91-09-27	30 +- 7	31 +- 5	30 +- 2	1.01
I-131	91-04-26	60 +- 8	61 +- 12	61 +- 6	1.01
	91-09-27	108 +- 16	109 +- 17	101 +- 8	0.94
K(mg/L)	91-04-26	1650 +- 117	1653 +- 324	1729 +- 88	1.05
	91-09-27	1740 +- 123	1667 +- 242	1714 +- 87	0.99

* : Excluding those results significantly different from the population mean.

92-03-04

TABLE 5.09
Point Lepreau Generating Station
Environmental Radiation Monitoring
Quality Assurance Program
91-01-01 to 91-12-31

EPA Tritium in Water pCi/L +- 2 sigma

Analysis	Sample Date	EPA	* All Participants	NB Power	NB Power/EPA
H-3	91-02-22	4418 +- 625	4438 +- 666	3747 +- 219	0.85
	91-06-21	12480 +- 1765	12435 +- 1882	11157 +- 354	0.89
	91-10-18	2454 +- 498	2532 +- 677	2377 +- 197	0.97

* : Excluding those results significantly different from the population mean.

APPENDICES

6.0 SOURCE EMISSION DATA

Tables 6.01 and 6.02 summarize the emissions from PLGS since 1983. Note that in these tables, the Annual DEL for each radionuclide is indicated whereas in station operation a monthly or weekly DEL is used in monitoring. Based upon the total % DEL for all monitored radionuclides in each pathway for the year, the calculated whole body radiation dose to members of a hypothetical Critical Group residing at the boundary fence all year was about 0.1 microsievert from liquid effluent emissions and 0.8 microsievert from airborne effluent emissions (comparable with previous years).

Because of the protective assumptions used in the DEL calculations, the most exposed member of the general public received far less than these dose levels. This calculated radiation dose may be compared with the natural radiation dose in the Point Lepreau area of approximately 2000 to 3000 microsieverts per annum. This includes natural dose contributions from ground, air, food and from an assumed low concentration of radon in homes - whereas a significant fraction of Canadian homes contain radon which gives a radiation dose which can be much larger than this. In addition, an average per caput medical radiation dose is about 500 microsieverts per annum.

The regulatory General Public dose limit for emissions in 1991 was 5000 microsieverts per annum to the whole body (called effective dose), and 50 000 microsieverts to individual organs. These dose limits will change for members of the General Public in the future to 1000 microsieverts per annum to the whole body. With this limit, organ doses become relatively unimportant.

Figure 6.1 shows the power level achieved since 1982, on a monthly basis.

The information for the Liquid Effluent and Airborne pathways from PLGS is used not only to control the frequency of sample collection in the Environmental Radiation Monitoring Program but also to indicate which pathways and sample types may need to be more closely examined.

To the present time, tritium, carbon-14 and iodine-131 are the only radionuclides detected off site which are attributable to the operation of PLGS. The correlation between observed and expected tritium levels in the air monitoring stations over the last eight years indicates that, for the airborne pathway, the assumed Dilution Factor of 2.2E-07 s/m^3 used in the DEL licensing document is sufficiently accurate.

TABLE 6.01

Liquid Effluent Pathway Emission Data (%DEL)

Radio-nuclide	Annual DEL (Bq)	1983	1984	1985	1986	1987
H-3	5E+19	1.9E-05	1.5E-04	5.1E-05	2.3E-04	2.0E-04
C-14	1E+15	.....	.....	.....	.....	.....
Cr-51	2E+16	3.2E-06	4.7E-05	1.2E-07	9.0E-08	3.4E-08
Mn-54	2E+14	1.2E-07	9.2E-05	6.0E-07	8.3E-06	4.1E-07
Co-58	8E+14	.....	1.0E-06	.....	.....	.....
Fe-59	1E+14	1.6E-05	7.2E-05	1.6E-06	.....	1.3E-06
Co-60	4E+14	2.3E-06	8.1E-05	4.1E-06	1.2E-05	3.3E-06
Zn-65	1E+14	.....	4.1E-07	1.8E-07	7.5E-06	.....
Sr-90	2E+15	.....	2.2E-08	3.8E-10	6.0E-07	4.0E-08
Zr-95	7E+14	7.4E-06	3.9E-05	1.7E-05	4.8E-05	2.0E-05
Nb-95	7E+14	1.2E-05	7.1E-05	2.9E-05	8.2E-05	3.2E-05
Ru-103	1E+15	4.6E-07	5.7E-09	4.2E-07	9.1E-07	2.4E-07
Ru-106	2E+14	.....	1.3E-06	.....	.....	.....
Ag-110m	1E+14	1.8E-07	7.3E-08	4.0E-07	4.9E-06	1.4E-06
Sb-124	1E+13	.....	.....	.....	.....	.....
I-131	1E+14	1.4E-03	3.4E-05	8.2E-04	3.3E-05	1.0E-07
Cs-134	5E+14	1.8E-07	2.3E-06	6.7E-08	3.7E-07	4.7E-07
Cs-137	8E+14	.....	7.6E-06	7.9E-07	3.1E-06	1.7E-06
La-140	2E+15	3.6E-08	1.1E-08	.....	.....	.....
Ba-140	2E+15	.....	.....	.....	.....	.....
Ce-141	2E+15	2.5E-08	1.1E-08	.....	.....	.....
Ce-144	2E+14	3.3E-06	8.1E-07	5.4E-07	1.6E-06	4.7E-07
Total % DEL		1.5E-03	6.0E-04	9.3E-04	4.3E-04	2.6E-04

Calculated annual dose in microsievert:

Whole body -	1.4E-02	2.9E-02	1.3E-02	2.0E-02	1.3E-02
Thyroid -	3.0E-01	3.8E-02	2.5E-01	3.0E-02	1.3E-02

TABLE 6.01 (Cont'd)

Liquid Effluent Pathway Emission Data (%DEL)

Radio-nuclide	Annual DEL (Bq)	1988	1989	1990	1991
H-3	5E+19	2.5E-04	6.8E-04	3.3E-04	2.4E-04
C-14	1E+15	.....	8.2E-06	.....	.....
Cr-51	2E+16	.....	1.6E-07	5.4E-06	1.9E-06
Mn-54	2E+14	4.6E-07	5.6E-06	2.0E-06	7.4E-07
Co-58	8E+14	.....	.....	.....	.....
Fe-59	1E+14	1.2E-06	7.4E-06	1.0E-05	2.1E-06
Co-60	4E+14	4.9E-06	4.3E-05	2.7E-05	1.4E-05
Zn-65	1E+14	.....	2.7E-06	4.8E-06	2.9E-05
Sr-90	2E+15	.....	4.0E-08	1.3E-08	4.1E-08
Zr-95	7E+14	7.8E-06	2.9E-05	7.4E-06	1.9E-05
Nb-95	7E+14	1.5E-05	5.9E-05	1.6E-05	2.9E-05
Ru-103	1E+15	3.3E-07	.....	8.7E-08	8.0E-08
Ru-106	2E+14	.....	.....	.....	.....
Ag-110m	1E+14	4.7E-06	3.6E-07	2.4E-06	1.9E-07
Sb-124	1E+13	.....	6.5E-04	2.9E-03	1.0E-03
I-131	1E+14	6.8E-04	2.3E-05	4.6E-07	2.0E-03
Cs-134	5E+14	9.0E-07	5.2E-08	6.6E-08	1.8E-06
Cs-137	8E+14	3.4E-06	1.4E-06	1.3E-06	4.2E-06
La-140	2E+15	.....	.....	.....	.....
Ba-140	2E+15	.....	.....	.....	.....
Ce-141	2E+15	8.1E-09	.....	1.2E-08	.....
Ce-144	2E+14	3.0E-07	.....	.....	.....
Total % DEL		9.7E-04	1.5E-03	3.3E-03	3.3E-03

Calculated annual dose in microsievert:

Whole body -	2.1E-02	7.5E-02	1.6E-01	8.5E-02
Thyroid -	2.2E-01	8.2E-02	1.6E-01	6.7E-01

The liquid effluent DEL for I-131 is based upon an adult-limiting thyroid dose of 30 mSv/a.

The whole body dose represents the dose calculated from all radionuclides emitted except I-131, but includes the 0.03 weighted contribution of the adult thyroid dose from I-131. The thyroid dose is the I-131 thyroid dose plus the whole body dose. The organ weighting factor for the thyroid will be changed to 0.05 in future years.

TABLE 6.02

Gaseous Effluent Pathway Emission Data (%DEL)

Radio-nuclide	Annual DEL (Bq)	1983	1984	1985	1986	1987
H-3	2E+18	1.6E-03	4.3E-03	6.8E-03	1.3E-02	1.4E-02
C-14 *	2E+16	.....	.....	.....	.....	.....
Co-60	5E+14	.....	.....	.....	.....	.....
Ru-106	2E+14	.....	.....	.....	.....	.....
I-131	3E+12	3.6E-04	.....	1.5E-04	1.1E-03	.....
Cs-134	1E+14	.....	.....	.....	.....	.....
Cs-137	3E+14	.....	.....	.....	.....	.....
Noble G	4E+17	1.2E-03	.....	2.5E-04	1.5E-03	2.7E-05
Total % DEL		3.2E-03	4.3E-03	7.2E-03	1.6E-02	1.4E-02

* This DEL assumes a cow at 1.5 km from the stack.

Calculated annual dose (at the boundary fence) in microsievert:

Whole body -	1.4E-01	2.2E-01	3.5E-01	7.3E-01	7.0E-01
Thyroid -	1.9E-01	2.2E-01	3.8E-01	8.9E-01	7.0E-01

The airborne DEL for I-131 is based on the infant limiting thyroid dose of 15 mSv/a. The calculated whole body dose is an approximation, as it is based on the DELs that apply to the adult, but includes the 0.03 component of the infant thyroid dose. In future years this weighting factor for the thyroid will be 0.05.

TABLE 6.02 (Cont'd)

Gaseous Effluent Pathway Emission Data (%DEL)

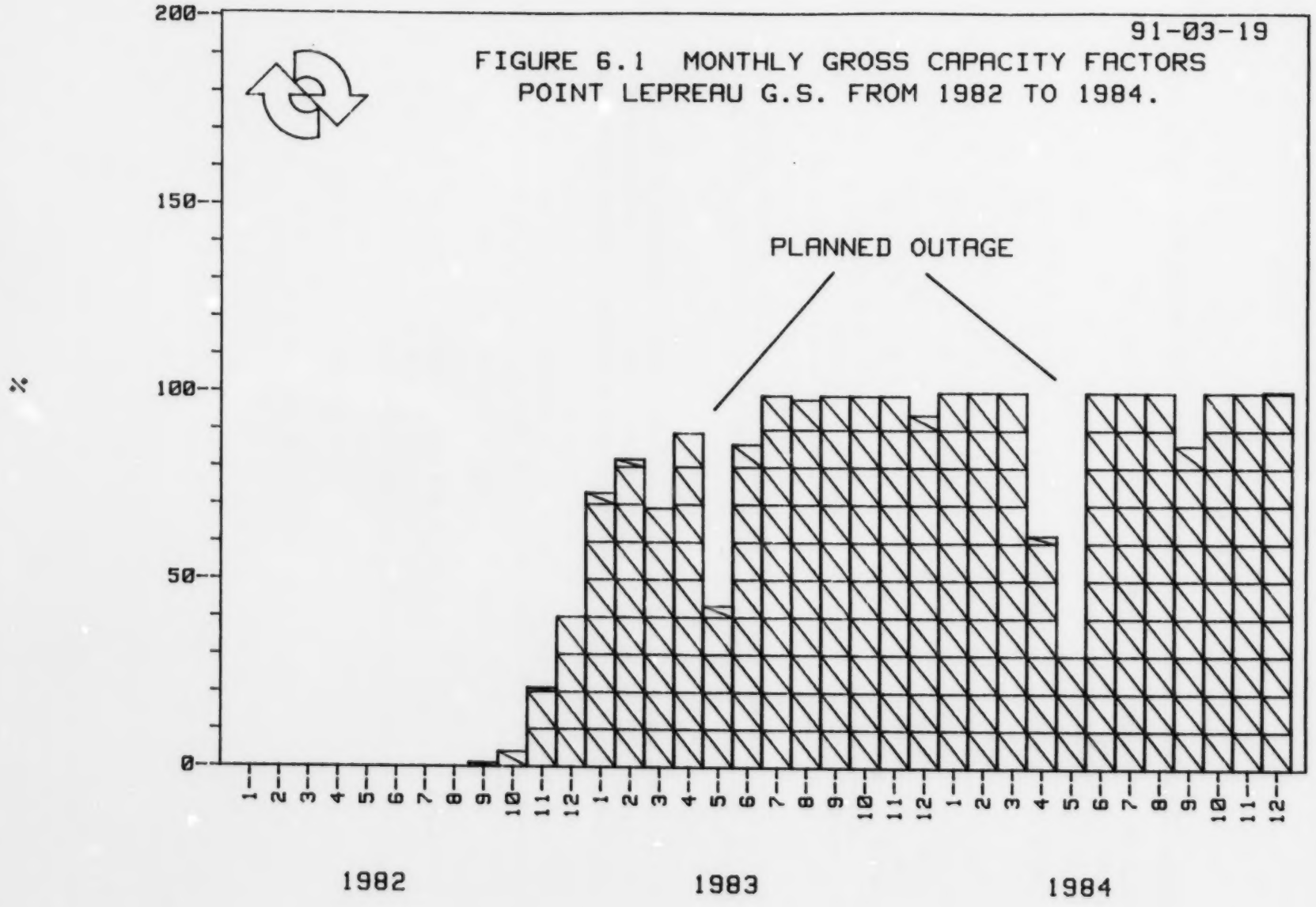
Radio-nuclide	Annual DEL (Bq)	1988	1989	1990	1991
H-3	2E+18	1.4E-02	1.3E-02	1.4E-02	1.1E-02
C-14 *	2E+16	.....	2.6E-03	5.8E-03	1.8E-03
Co-60	5E+14	.....	.....	.....	.....
Ru-106	2E+14	.....	.....	.....	.....
I-131	3E+12	1.8E-03	1.9E-04	.....	6.1E-04
Cs-134	1E+14	.....	.....	.....	.....
Cs-137	3E+14	.....	.....	.....	.....
Noble G	4E+17	9.6E-05	.....	.....	3.7E-03
Total % DEL		1.6E-02	2.9E-02	2.0E-02	1.7E-02

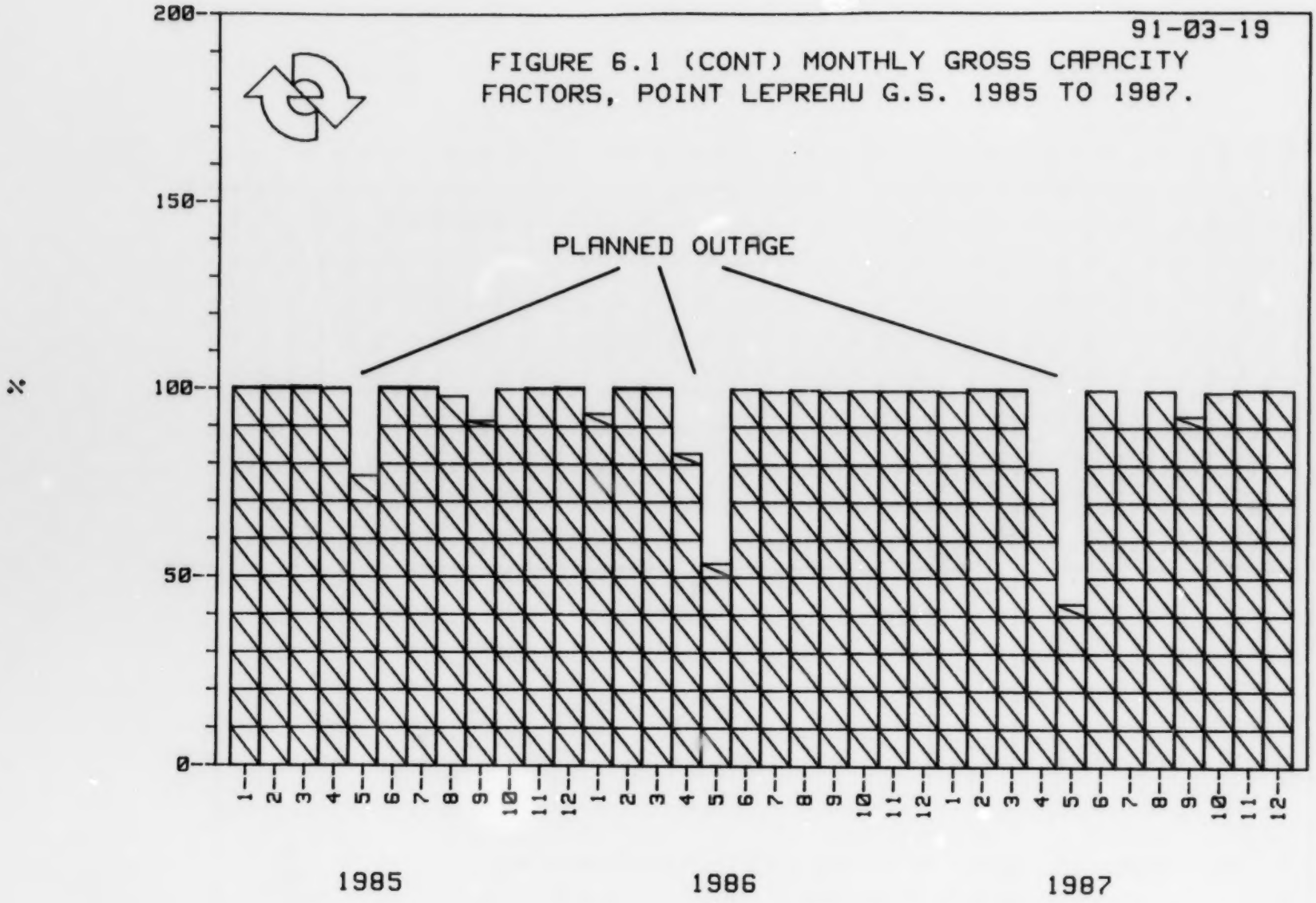
* This DEL assumes a cow at 1.5 km from the stack, which is the nearest practical distance that a cow could be grazing. The nearest cow in 1991 was at least 40 km distant.

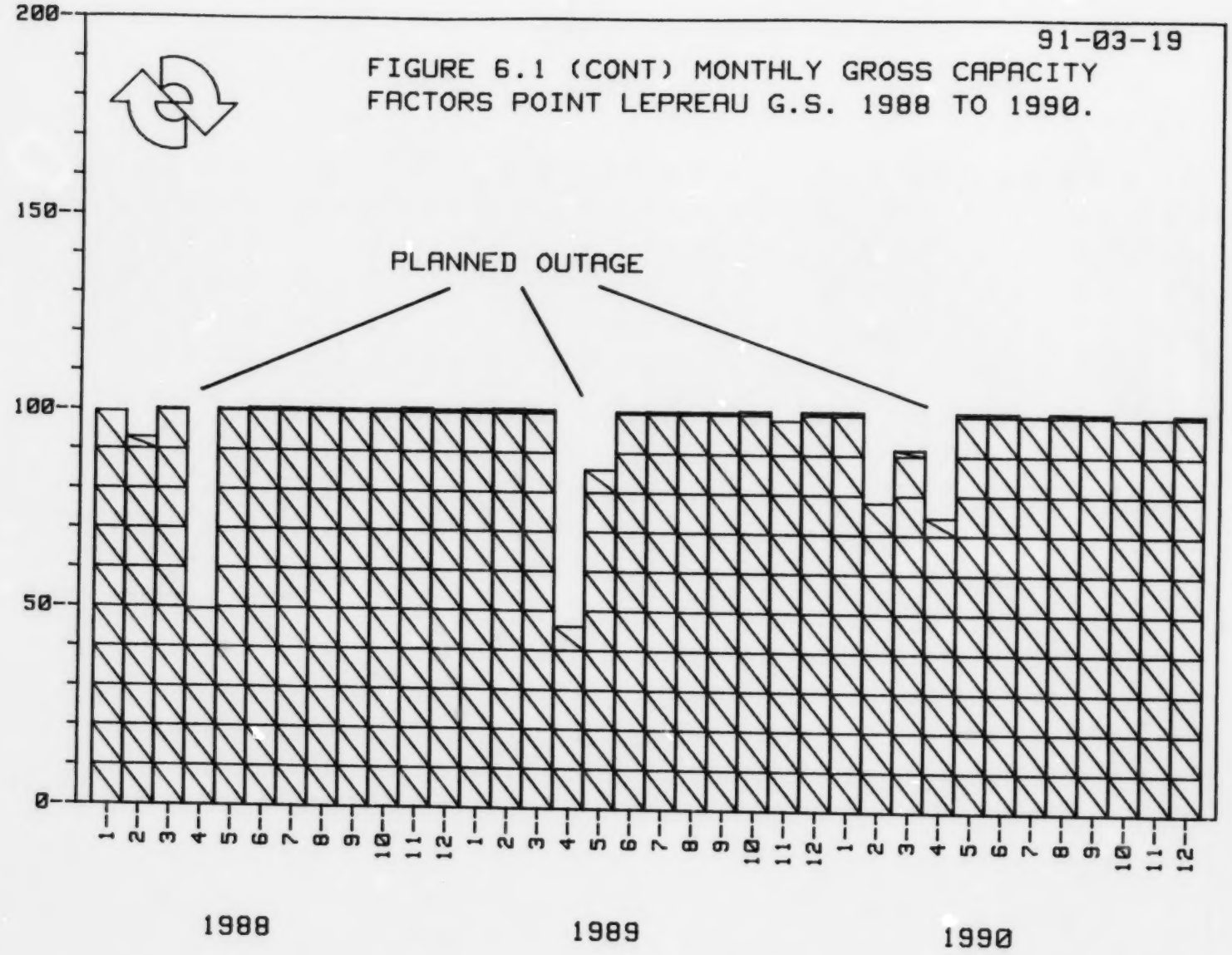
The C-14 DEL with the cow at 40 km is 1E+17 Bq/a, and the carbon-14 % DEL for 1991 becomes 3.5E-04, used in the calculation below. This calculation assumes that the infant living at the boundary fence in 1991, drank milk produced at least 40 km away.

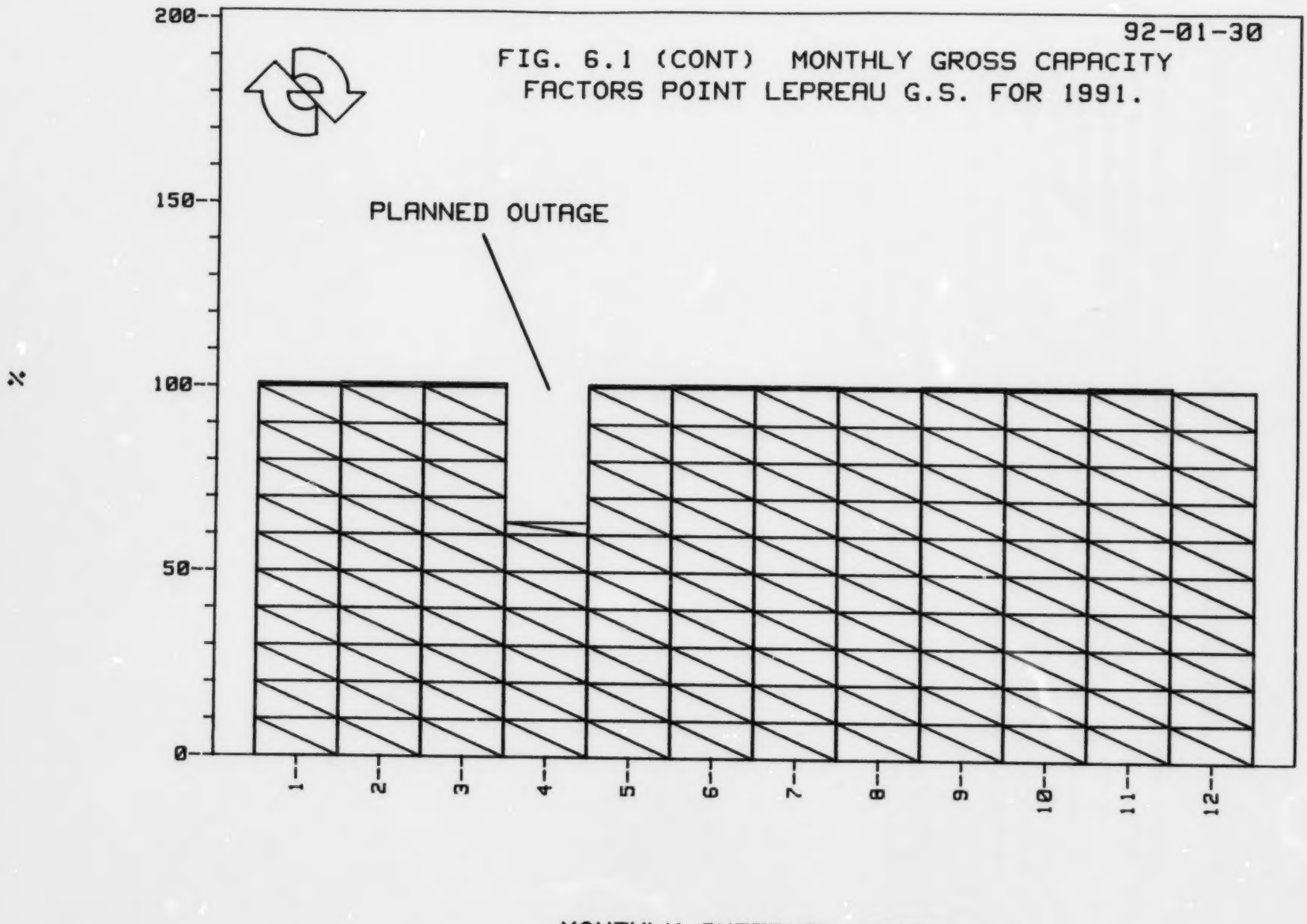
Calculated annual dose (at the boundary fence) in microsievert:

	1988	1989	1990	1991
Whole body -	7.1E-01	6.8E-01	7.6E-01	7.8E-01
Thyroid -	9.7E-01	7.0E-01	7.6E-01	8.7E-01


91-03-19
FIGURE 6.1 MONTHLY GROSS CAPACITY FACTORS
POINT LEPREAU G.S. FROM 1982 TO 1984.
PLANNED OUTAGE
%
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
1982
1983
1984
MONTHLY INTERVAL


91-03-19
FIGURE 6.1 (CONT) MONTHLY GROSS CAPACITY
FACTORS, POINT LEPREAU G.S. 1985 TO 1987.
PLANNED OUTAGE
%
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
1985
1986
1987
MONTHLY INTERVAL


91-03-19
FIGURE 6.1 (CONT) MONTHLY GROSS CAPACITY
FACTORS POINT LEPREAU G.S. 1988 TO 1990.
PLANNED OUTAGE
200
150
100
50
0
%
1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
1988
1989
1990
MONTHLY INTERVAL


92-01-30
FIG. 6.1 (CONT) MONTHLY GROSS CAPACITY FACTORS POINT LEPREAU G.S. FOR 1991.
PLANNED OUTAGE
%
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
11
12
MONTHLY INTERVAL, 1991

7.0 METEOROLOGICAL DATA AROUND POINT LEPREAU G.S.

The meteorological data for the 10 metre weather tower in the Point Lepreau area for 1991 and a compilation of the 1986 to 1991 data are presented in Tables 7.01 and 7.02. Data are collected hourly over the year. The computer linkage providing data for this report shows gaps in reporting to the extent of about 5 to 10% in the year. However, meteorological data for the 10 metre tower, provided directly to PLGS are more complete. Wind Rose data for 1991 are presented in Figure 7.1 and a pie-plot of the average percentage frequency of Pasquill stability classes for these six years in the Point Lepreau area is presented in Figure 7.2.

As long term weather data are not available for this location, data for a recent twenty year interval for both Saint John and Fredericton, the nearest locations for which such data are available, are presented in Tables 7.03 and 7.04.

TABLE 7.01

METEOROLOGICAL DATA FOR POINT LEPREAU, NEW BRUNSWICK (1991)

Month	Temperature Mean daily Av	Mean daily Max	Mean daily Min	Extreme Max	Extreme Min	Wind direction % Observations From * N	NE	E	SE	S	SW	W	NW	Pasquill stability classes A	B	C	D	E	F	G	UNAV.
	degrees Celsius					Relative %										Relative %					%
January	-7.0	-2.3	-11.6	4.4	-22.6	26	6	3	3	6	11	20	26	17	6	7	23	24	14	9	#
February	-3.6	0.2	-7.5	5.3	-17.4	14	9	5	3	11	21	19	18	16	6	7	23	26	13	10	2
March	-0.4	2.6	-3.4	6.9	-8.7	23	17	5	6	11	9	11	18	9	4	4	19	26	21	16	1
April	3.0	5.7	0.3	15.7	-4.0	9	27	9	2	8	20	14	10	11	2	4	21	36	15	12	19
May	8.7	12.4	5.9	25.8	0.4	12	9	8	3	13	27	14	13	6	2	3	16	32	21	20	4
June	10.4	14.0	8.0	20.6	6.6	6	14	7	3	13	28	13	17	5	2	4	17	31	21	19	46
July	14.1	17.2	11.6	24.5	9.3	2	7	9	3	13	34	24	8	1	1	1	10	22	26	40	18
August	14.2	17.1	12.0	24.2	8.9	5	12	8	3	17	28	20	5	1	1	1	5	25	34	25	2
September	11.3	14.1	8.8	18.8	1.6	9	4	2	3	14	24	19	24	3	2	2	14	29	31	19	#
October	8.8	11.1	6.7	19.1	0.1	12	12	10	5	22	18	9	13	4	2	2	18	34	29	12	#
November	3.6	6.4	1.0	12.2	-6.2	16	14	6	4	5	12	15	28	7	2	4	31	33	18	4	#
December	-4.6	-0.1	-9.4	10.3	-18.5	24	8	3	1	7	10	19	29	17	8	9	27	26	9	4	1
Means	4.6	7.9	1.5	25.8	-22.6	14	11	6	3	12	19	17	18	8	3	4	19	28	21	16	8
Years	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

10 Metre Tower data.

* Each compass direction covers ± 22.5 degrees.

UNAV means that percentage of time that the instrumentation was unavailable and could not record the weather.

\# means unavailable less than 1% of the time.

TABLE 7.02

METEOROLOGICAL DATA FOR POINT LEPREAU, NEW BRUNSWICK (six year average)

Month	Temperature Mean daily Av	Mean daily Max	Mean daily Min	Extreme Max	Extreme Min	Wind direction % Observations From * N	NE	E	SE	S	SW	W	NW	Pasquill stability classes A	B	C	D	E	F	G	UNAV.
	degrees Celsius					Relative %								Relative %							%
January	-4.8	-0.7	-8.8	6.1	-24.0	16	8	5	3	9	12	19	27	19	9	8	26	22	12	5	3
February	-5.2	-1.7	-9.3	5.8	-21.0	18	9	4	2	7	15	17	28	22	11	11	23	19	9	5	1
March	-1.5	1.6	-4.7	13.3	-24.5	16	14	6	3	12	15	13	20	16	8	8	25	25	12	7	2
April	3.3	5.9	1.0	15.7	-4.3	15	25	11	4	15	15	9	7	12	5	7	25	33	12	6	15
May	7.6	10.8	5.1	25.8	-1.0	11	16	11	3	17	23	11	7	8	4	6	21	31	17	13	18
June	10.9	14.1	8.4	24.0	4.3	6	14	12	4	16	23	15	9	4	2	3	16	36	23	16	14
July	13.5	16.5	11.1	25.3	6.5	4	9	9	4	19	29	19	8	2	1	2	11	31	27	27	9
August	14.0	16.8	11.7	24.2	7.9	6	7	9	5	18	26	20	8	2	1	1	9	29	32	26	7
September	11.6	14.2	9.3	25.6	1.1	8	8	6	4	15	26	18	16	5	2	3	18	34	25	12	6
October	8.2	10.5	5.7	19.1	-1.6	12	9	8	6	16	19	17	14	5	4	5	27	30	17	12	3
November	2.8	5.7	-0.2	13.1	-13.1	13	9	4	5	11	12	20	26	9	5	8	34	25	15	4	1
December	-3.8	0.0	-7.8	10.3	-21.5	17	7	4	3	6	10	23	31	18	11	11	27	21	9	3	5
Means	4.7	7.9	1.9	25.8	-24.5	12	11	7	4	13	19	17	17	10	5	6	22	28	17	11	7
Years	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6

10 Metre Tower data, 1986-01-01 to 1991-12-31.

* Each compass direction covers + 22.5 degrees.

UNAV means that percentage of time that the instrumentation was unavailable and could not record the weather.

\# means unavailable less than 1% of the time.

TABLE 7.03
METEOROLOGICAL DATA FOR SAINT JOHN, NEW BRUNSWICK(*)

Month	P	Temperature Mean daily Av	Mean daily Max	Mean daily Min	Extreme Max	Extreme Min	RH	CC	Precip Av	Precip 24h	Days with r	s	ppt	f	th	Wind direction % Observations From N	NE	E	SE	S	SW	W	NW	c	ms
	kPa	degrees Celsius					%	%	mm	mm															knots
Jan	101.4	-7.4	-2.3	-12.6	11.1	-31.1	82	64	145.0	69.3	6	14	17	3	0.2	22	6	7	4	5	7	18	27	4	11.3
Feb	101.2	-7.5	-2.1	-12.9	10.6	-36.7	80	59	130.8	95.0	5	12	14	3	0.1	19	7	8	5	8	9	18	22	4	11.1
Mar	101.3	-2.6	2.0	-7.3	13.9	-30.0	77	63	104.7	54.6	7	10	14	5	0.1	22	8	9	5	9	8	15	21	3	11.5
Apr	101.4	3.1	7.9	-1.8	20.0	-16.7	75	65	111.8	125.5	11	4	13	6	0.7	20	7	8	8	16	11	11	14	5	10.4
May	101.4	8.8	14.3	3.2	30.0	-7.8	72	68	101.9	62.0	14	1	14	10	0.8	12	6	9	9	25	16	7	11	5	10.1
Jun	101.3	13.6	19.1	8.0	31.7	-2.2	77	70	94.5	54.1	13	0	13	12	2.7	10	6	8	9	33	17	5	7	5	9.7
Jul	101.4	16.9	22.3	11.4	32.8	1.1	80	65	89.4	72.6	12	0	12	17	3.0	7	3	6	8	39	17	7	7	6	8.8
Aug	101.5	16.3	21.7	10.9	31.1	-0.6	82	60	98.8	125.2	12	0	12	14	2.5	9	4	4	8	33	16	9	10	7	8.6
Sep	101.8	12.7	17.8	7.4	28.9	-6.7	82	57	102.6	74.9	12	0	12	13	1.1	12	6	7	7	25	13	9	13	8	9.0
Oct	101.7	7.9	12.7	3.1	25.6	-9.4	83	57	109.7	85.3	11	1	12	9	0.6	15	7	5	7	19	14	14	14	5	10.1
Nov	101.5	2.6	6.6	-1.6	21.7	-14.4	85	68	154.4	73.4	13	4	15	5	0.2	19	7	7	8	12	8	16	19	4	10.8
Dec	101.5	-4.6	-0.2	-9.1	15.0	-26.7	82	62	156.7	105.7	8	12	16	3	0.1	22	7	5	5	7	7	17	26	4	11.2
Means	101.5	5.0	10.0	-0.1												15	6	7	7	20	12	12	16	5	10.3
Totals									1400		123	58	164	99	12.1										
Extremes					32.8	-36.7				125.5															
Years	20	22	22	22	22	22	10	13	22	22	22	22	22	30	20	18	18	18	18	18	18	18	18	18	18

* Data from "Small Craft Guide to the Saint John River." available from the Lower Saint John River Promotion Association, Box 210, Gagetown, N.B. and bookstores.

P means Mean Sea Level Pressure in kiloPascals.
Av means Average Monthly Temperature.
RH means Relative Humidity in percent.
CC means Cloud Cover in percent.
Precip. mm means average total precipitation in millimetres for the month.
Precip. max means maximum precipitation in millimetres recorded in 24 hours.
r,s,ppt,f,th means days with rain, snow, precipitation, fog and thunder respectively.
c means percentage of observations that are calm weather.
ms means mean wind speed in knots, (1 knot = 1.85 km/h)

TABLE 7.04
METEOROLOGICAL DATA FOR FREDERICTON, NEW BRUNSWICK(*)

Month	P	Av	Temperature Mean daily Max	Mean daily Min	Extreme Max	Extreme Min	RH	CC	Precip. Av	Precip. 24h	Days with r	s	ppt	f	th	Wind direction % Observations From N	NE	E	SE	S	SW	W	NW	c	ms
	kPa	degrees celsius					%	%	mm	mm															knots
Jan	101.6	-8.8	-3.7	-14.0	11.1	-33.9	72	61	95.3	38.4	5	12	15	2	0.0	7	9	4	2	7	15	28	16	12	8.2
Feb	101.2	-8.1	-2.3	-13.8	13.3	-37.2	73	59	92.5	51.8	3	11	13	2	0.0	6	12	5	2	10	14	26	13	12	8.2
Mar	101.2	-2.4	2.5	-7.4	22.2	-24.4	70	61	69.1	37.9	5	9	12	2	0.1	10	13	7	2	9	10	23	17	9	8.7
Apr	101.3	4.2	9.6	-1.3	24.4	-14.4	64	64	73.9	58.7	10	4	12	2	0.5	11	12	7	4	14	10	17	15	10	8.1
May	101.3	10.6	16.9	4.1	32.8	-6.7	62	65	81.3	83.8	13	0	13	2	1.1	8	11	7	5	21	13	14	13	8	8.0
Jun	101.2	16.1	22.6	9.6	35.0	0.0	67	66	79.3	69.9	13	0	13	3	2.2	6	10	5	6	30	15	12	8	8	7.5
Jul	101.3	19.2	25.6	12.8	36.7	1.7	70	57	88.1	69.1	12	0	12	4	3.8	4	5	3	5	34	17	13	8	11	6.9
Aug	101.4	18.1	24.3	11.7	36.1	1.7	72	58	87.6	76.5	11	0	11	4	3.0	3	5	3	5	30	18	16	9	11	6.7
Sep	101.6	13.4	19.6	7.2	32.8	-2.8	75	54	81.8	71.9	10	0	10	6	0.7	5	8	4	4	24	17	16	11	11	6.7
Oct	101.7	7.8	13.3	2.3	27.8	-8.9	77	59	88.1	54.6	11	1	11	5	0.5	7	9	3	3	20	17	18	12	11	7.3
Nov	101.5	1.7	6.0	-2.6	21.1	-17.8	80	66	109.2	81.0	11	5	14	5	0.1	8	12	5	4	13	15	20	12	11	7.5
Dec	101.5	-6.2	-1.5	-10.8	15.0	-32.2	77	62	114.1	81.3	6	12	15	3	0.1	7	9	4	2	9	15	26	15	13	7.9
Means	101.4	5.5	11.1	-0.2												7	10	4	3	19	15	19	12	11	7.7
Totals									1060		110	54	151	40	12.1										
Extremes					36.7	-37.2				83.8															
Years	20	20	20	20	20	20	10	10	20	20	20	20	20	30	20	18	18	18	18	18	18	18	18	18	18

* Data from "Small Craft Guide to the Saint John River." available from the Lower Saint John River Promotion Association, Box 210, Gagetown, N.B. and bookstores.

P means Mean Sea Level Pressure in kiloPascals.
Av means Average Monthly Temperature.
RH means Relative Humidity.
CC means Cloud Cover in percent.
Precip. mm means average total precipitation in millimetres for the month.
Precip. max means maximum precipitation in millimetres recorded in 24 hours.
r,s,ppt,f,th means days with rain, snow, precipitation, fog and thunder respectively.
c means percentage of observations that are calm weather.
ms means mean wind speed in knots, (1 knot = 1.85 km/h).

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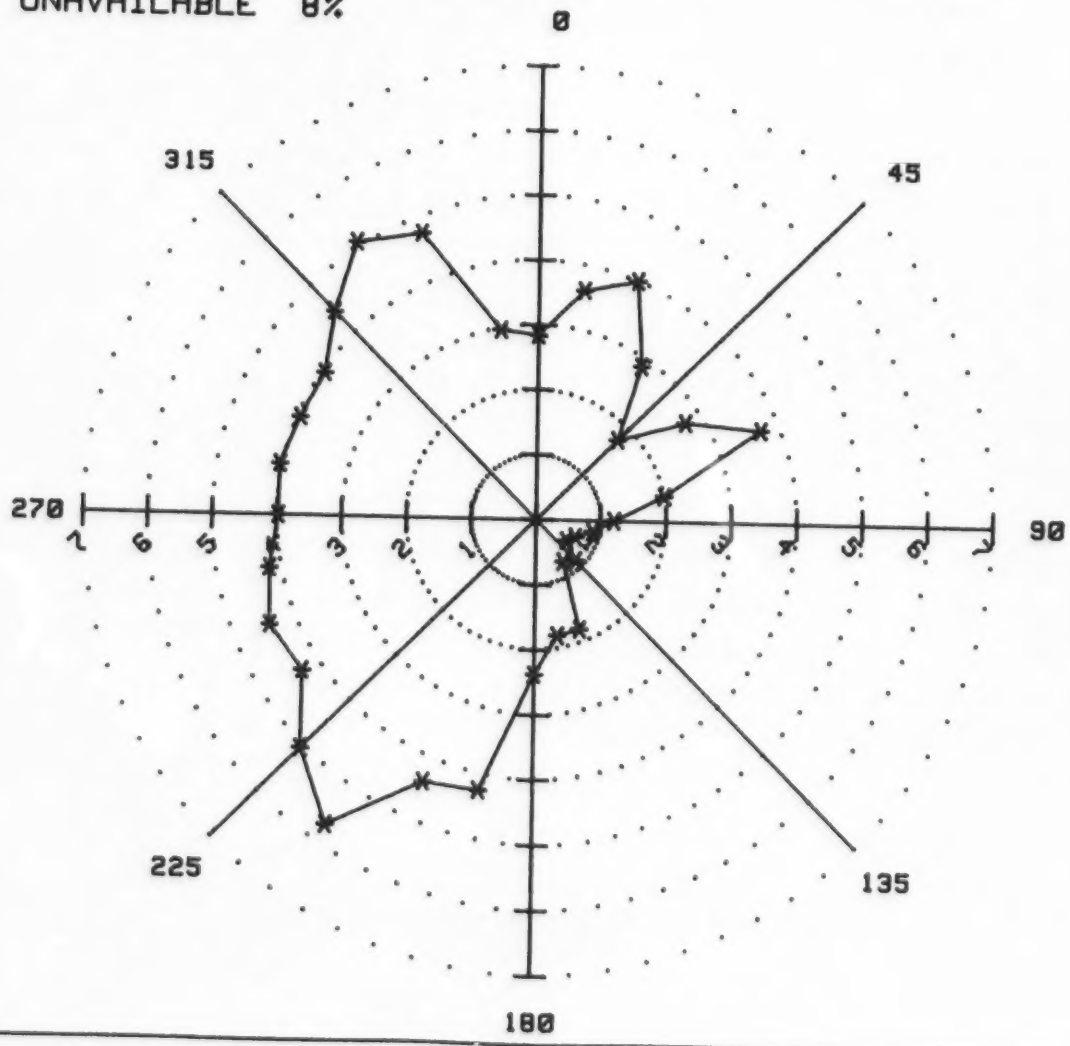
FIGURE 7.1 WIND ROSE DATA FOR 1991
PERCENT FREQUENCY, POINT LEPREAU, N.B.

UNAVAILABLE 8%

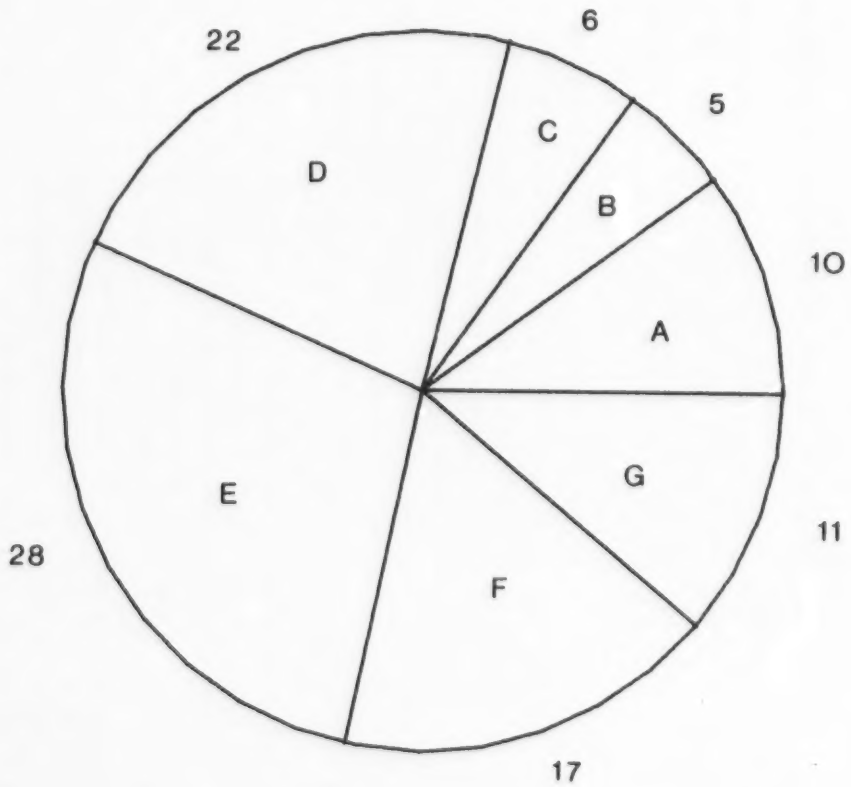


92-02-04

FIGURE 7.2 PASQUILL STABILITY CLASSES
PERCENT FREQUENCY, POINT LEPREAU 1986 TO 1991

PERCENTAGES

6 YEAR COMPOSITE
UNAVAILABLE 7%



8.0 STATISTICS, ANALYTICAL TECHNIQUES, SAMPLE COLLECTION

8.1 Introduction

This section provides a summary of statistics, analytical techniques, analyses and detection limits used in the Health Physics Environmental Laboratory.

8.2 Statistics

The following statistical conventions are applied in the analysis of each sample:

1) Detection limits are defined following the method described by Lochamy (NBS Special Publication 456 - Measurements for the Safe Use of Radiation, U.S. Department of Commerce, 1976). The Lower Limit of Detection (LLD) at the 99% confidence level is defined as 6.58 Sb, where Sb is the standard deviation of the appropriate, ill-defined, background measurement. Such an ill-defined background is typical of the germanium detector analyses, liquid scintillation analyses and alpha/beta determinations. This LLD corresponds to that amount of activity in a sample that will yield a net count greater than 3.29 Sb, i.e., the so-called Critical Level (CL), with 99% probability. The LLD specifies the theoretical capability of the system to quantify a given amount of radioactivity, whereas the CL is used to determine in practice whether a single activity measurement should be considered "detected". Any individual measurement greater than 3.29 Sb is considered detected at the 99% confidence level. This also implies a 1% probability of stating that activity is present when it is not (false positive). If activity is present at the LLD level (6.58 Sb) there is a 1% probability of stating that activity is not present when it is (false negative). In most of the tables of data (Section 3.0), it is this Critical Level that appears in column 1. Where there are sufficient background data to provide a well defined background as for example with the TLD data, the CL is defined as 2.33 Sb and the LLD as 4.66 Sb.

2) Unless otherwise indicated, the precision of the measurements reported here is given as $\pm$ 1.96 Sa (95% confidence level), where Sa is the standard deviation of the activity measurement.

3) The value and standard deviation are reported with two significant figures using modified scientific notation, for example 0.032 is expressed as 3.2E-02.

8.3 Analytical Techniques

The major analytical techniques and the instruments used in routine environmental analysis are summarized in Table 8.01. In the case of gamma spectrometry analysis, all significant peaks in the spectrum are identified either by reference to a library of about 100 radionuclides in a computer file, or by manual reference to compilations of all known radionuclides. In addition, approximately 20 "selected" radionuclides are specifically searched for in every sample with the exception of Air Iodine samples in which only I-131 is "selected". The "selected" radionuclides include those which are produced in PLGS and which would be readily detectable because of their abundance (high fission yield) and high branching ratios for gamma emissions. Naturally occurring gamma emitters - daughter radionuclides of uranium and thorium; cosmogenic radionuclides and any of the 18 or so known radioactive species found in nature - are present in most samples, but with the exception of Be-7, K-40 and Ac-228 are not included in this report. The latter radionuclides are sometimes useful as general indicators of the consistency of the analytical techniques and are thus reported.

The usefulness of alpha/beta analysis lies primarily in screening samples to determine whether or not more detailed analyses should be performed. The reported alpha and beta values are assessed using Am-241 and Sr-Y-90 calibration sources respectively.

Wet chemical analyses for Sr-90 on Gaseous Effluent (airborne) Monitoring (GEM) and Liquid Effluent Monitoring (LEM) samples covering the entire year indicated that emissions of Sr-90 in 1991, were sufficiently low (generally below the LLD), that it would be pointless to analyze environmental samples in the expectation of seeing this radionuclide.

TABLE 8.01

SUMMARY OF ANALYTICAL TECHNIQUES

Analytical technique	Instrumentation
Gamma Spectroscopy	A Canberra 24% efficient * intrinsic germanium detector, in an Applied Physical Technology 10 cm graded lead cave. A NaI(7.6x7.6 cm) detector in an APT 10 cm graded lead cave. Ortec Model 7010 multichannel analyser (4096 channels). Hewlett-Packard 9845B microcomputer for automatic data reduction (20 megabyte hard disc storage capacity).
Liquid Scintillation (Tritium and C-14)	Beckman LS-6000TA analyzer.
Gross Alpha/Beta and Sr-90 Analyses	Tennelec LB-5100 alpha/beta detector.
Thermoluminescence Dosimetry	Panasonic UD-710A Automatic TLD Reader and UD-814AQ dosimeters.
Chemical analysis	Laboratory separation and analysis for Sr-90 on various sample types. The final analysis is by Tennelec alpha/beta counting.

* relative to a sodium iodide detector of the same size.

8.4 Sample Collection, Analysis and Detection Limits

8.4.1 Airborne Particulates

Collection

Airborne particulates are collected on a 47mm diameter Gelman Type A glass fibre filter through which air is drawn at up to 60 L/min (approximately 2400 m^3 for a 28 day continuous sample). The volume of air sampled is measured with an in-line integrating dry gas meter. Every four weeks the filters are replaced and the used ones returned to the laboratory for analysis. Sampling is therefore continuous throughout the year, the only interruption, other than because of power failure or pump breakdown, being the five minute filter change. About 2% of collection time was lost due to breakdown and power electrical failures.

Analysis and Detection Limits

Air particulate filters are analyzed by gamma spectrometry as soon as possible after collection to ensure detection of any short lived gamma emitters that may be present, and to minimize any decay corrections. Samples are counted for 5000s on a 24% efficient intrinsic germanium gamma spectrometer. Typical LLDs are given in Table 8.02 for a 1200 m^3 sample. The LLDs are decay corrected to the time of sample collection. Throughout this section and in the data tables, the radionuclides are listed in order of increasing "selected" photon energy, (exceptions to this are the additional data for gross alpha, gross beta, tritium and Ru-106). Ruthenium-106 is a pure beta emitter only, but is a long lived parent of the short half life Rh-106 which is used for the analysis. Decay corrections are based upon the parent half life.

Approximately three days after the end of the sample collection interval, each filter is counted for 100 minutes for the simultaneous determination of gross alpha and gross beta activity. Counting is delayed for this length of time to allow for the decay of activity of the short-lived naturally occurring radon daughters which are present in all of these samples and which would otherwise complicate the analysis.

TABLE 8.02

LLDs ON AIR PARTICULATE SAMPLES

Nuclide	LLD (Bq/m^3)
Gross alpha	4E-05
Gross beta	8E-05
Ce-144	1E-03
Ce-141	4E-04
Cr-51	2E-03
I-131	3E-05
Be-7	4E-03
Ru-103	2E-04
Ba-140	1E-03
Cs-134	2E-04
Ru-106	2E-03
Cs-137	2E-04
Zr-95	4E-04
Nb-95	2E-04
Co-58	2E-04
Mn-54	2E-04
Ag-110m	4E-04
Ac-228	8E-04
Fe-59	6E-04
Zn-65	8E-04
Co-60	4E-04
K-40	6E-03
La-140	4E-04

8.4.2 Airborne Radioiodine

Collection

Airborne radioiodine is collected in anactivated charcoal cartridge placed downstream from the glass fibre filter used to collect the airborne particulates. The cartridges used are Nuclear Consulting Services NUSORB (47 mm diameter and 48 mm length) charcoal cartridges containing 5% TEDA by weight. For a 28 day continuous sample approximately 2400 m^3 of air is sampled at a flow rate of 60 L/min. The volume of air sampled is measured with an in-line integrating dry gas meter.

Analysis and detection limits

Iodine-131 is the major nuclide of interest on the charcoal cartridges. To more efficiently use the available counting time, the cartridges are analyzed in groups of four, for 50 000 s on the gamma spectrometer as soon as possible after collection because of the relatively short half life of I-131 (8 days). If radioiodine is detected, then the cartridges are re-analyzed individually and an activity per cubic metre assigned to corresponding locations. Other fission product radioiodines, with much shorter half lives (minutes to hours), decay before they reach the sample location or during the time the sample is being collected. A typical LLD for I-131 is about 3E-05 Bq/m³ of air. This is an order of magnitude improvement over the previous counting strategy where samples were analyzed individually for 5000 s. If a significant release of radioiodine were noted from the station in this interval, the samples would be changed and analyzed earlier to minimize errors from decay corrections.

8.4.3 Airborne Tritium

Collection

A fraction of the flow in the air monitoring sample train is diverted through a molecular sieve container where water vapour is trapped. The volume of air passed through the molecular sieve is measured with an in-line integrating dry gas meter. The sieve material is later heated to 450 degrees C to drive off absorbed water which is then condensed and collected for analysis. Sampling is continuous at each location throughout the year, but is interrupted for a few minutes every four weeks to exchange sieve containers. Since the amount of water absorbed by the molecular sieve from a given volume of air depends upon relative humidity, flow rates are adjusted seasonally (using a Dwyer flow meter) to avoid saturation of the sieve material and to ensure adequate sample collection.

Analysis and Detection limits

For tritium analysis by liquid scintillation techniques, 6 mL of water taken from the molecular sieve are mixed with 15 mL of Aquasol-II, and counted for 100 minutes. The LLD is approximately 1E-01 Bq/m³ of air for a typical sample, corresponding to about 1E-03% of the tritium DAC for the general public.

8.4.4 Airborne Carbon-14

Collection

Airborne carbon dioxide is collected in a 1 L volume of 2N caustic soda solution at two environmental monitoring locations. One is at the Lighthouse location (G02), and the

other is at the Information Centre (H04). The volume of air sampled is assessed by gravimetric analysis of the dissolved carbon dioxide precipitated from solution as barium carbonate.

Analysis and Detection Limits

Carbon-14 is determined by liquid scintillation analysis of a 6 mL aliquot of the solution in 15 mL of Aquasol-II. The LLD is about 0.5 Bq/m^3 of air.

8.4.5 Environmental Gamma Radiation

Thermoluminescence Dosimetry (TLD)

Environmental gamma radiation is measured by thermo-luminescence dosimetry for each of 37 locations on a quarterly basis. Last year, additional TLDs were placed adjacent to the newly constructed Dry Fuel Storage cannisters for a total of 65 locations. Twenty cannisters were constructed by the end of 1991 and ten of them were filled with used fuel and sealed before the end of the year. Contact dose rates were generally about 1 to 2 microsieverts per hour. Ambient radiation dose rates just inside the fence of this facility were no different from background radiation levels for this location before used fuel was placed in these cannisters.

The phosphor is contained in a holder comprising three elements of lead-filtered calcium sulphate and one of lithium borate. The assembly, heat sealed in plastic and further protected in a thin walled plastic bag, is suspended about 1 m above the ground. The LLD at the 99% confidence level (i.e., 4.66 standard deviations above a well defined background) is approximately 10 microsieverts. All natural background radiation measurements are considerably higher than this. The expected precision is about + 10% at the 95% confidence level.

Measurements of the ambient radiation levels in the Point Lepreau area are given in Table 3.05A. The data in the "Total" column are rounded to the nearest ten micro-sieverts. If a quarterly measurement is not available (lost TLD, moisture penetration, etc.) a mean value is calculated from the available measurements in order to provide an estimate for the annual total. The statistical uncertainty shown in the Total column is the square root of the sum of the squares of the uncertainties of the individual quarterly measurements. A summary of TLD results since 1978 is given in Table 3.05B.

Environmental Dose Rate Survey Measurements

Gamma dose rate measurements (Beach Surveys) are taken quarterly on beaches and mud flats in the Point Lepreau area with an environmental gamma survey meter (Nuclear Enterprises type PDR1 or equivalent, capable of determining ambient radiation levels

down to about 0.01 to 0.05 microsievert/hour). In these inter-tidal locations it is impracticable to use TLDs.

8.4.6 Sediment

Collection and preparation

Beach and mudflat sediments (sand, silt and clay) are collected near the low tide mark with preference being given to the top 50 mm of the finely-divided silts characteristic of tidal mud flats. Disposable polyethylene containers are used to collect about 2 kg of sample which is later transferred to disposable aluminum trays for drying. Dried caked samples are broken into their original free granular form with a porcelain mortar and pestle and sieved through a 0.2 mm sieve to collect the fines for analysis (a 1 mm sieve is used for coarse sediments).

Analysis and Detection Limits

Approximately 0.25 kg of dried sediment is counted for 5000 s on the gamma spectrometry system.

TABLE 8.03

LLD IN SEDIMENTS

Nuclide	LLD (Bq/kg)
Ce-144	2E+01
Ce-141	8E+00
Cr-51	4E+01
I-131	8E+00
Be-7	4E+01
Ru-103	2E+00
Ba-140	2E+01
Cs-134	4E+00
Ru-106	4E+01
Cs-137	6E+00
Zr-95	6E+00
Nb-95	2E+00
Co-58	2E+00
Mn-54	4E+00
Ag-110m	4E+00
Ac-228	4E+01
Fe-59	6E+00
Zn-65	4E+00
Co-60	4E+00
K-40	2E+01
La-140	1E+01

8.4.7 Soil

Soil samples were not analyzed in 1991.

8.4.8 Water (Well Water/Sea Water)

Collection and Analysis

A 4 L sample of well water or sea water is collected and acidified with 15 mL of concentrated Nitric acid. About 20 mL of each sample, taken out before acidification, are used for tritium analysis (the seawater is distilled). Well water samples (125-500 mL, depending upon the dissolved solids content) are evaporated to dryness on stainless steel planchets for gross alpha/beta analysis. Other water samples collected and analyzed include those at the SRWMF and Dry Fuel Storage, i.e., Bore Hole waters, Cell Drainage water (if present) and surface run-off collected in the Parshall Flume. Lagoon water samples from within the PLGS exclusion boundary are also analyzed.

Analysis and Detection Limits

For gross alpha/beta analysis of well water, dried samples are counted for 100 minutes on a Tennelec LB-5100 alpha/beta counting system. For tritium analysis, a 6 mL sample of fresh water or sea water distillate is mixed with 15 mL of Aquasol-II and counted for 100 minutes by liquid scintillation. For gamma spectrometry analysis a 3.6 L sample is counted for 5000 s on the gamma spectrometer. Typical LLDs are listed below.

TABLE 8.04

LLD IN WELL WATER AND SEA WATER

Nuclide	Well Water LLD (Bq/L)	Sea Water LLD (Bq/L)
Gross alpha	1E-01	NA
Gross beta	1E-01	NA
H-3	4E+01	4E+01
Ce-144	2E+00	4E+00
Ce-141	1E+00	6E-01
Cr-51	4E+00	4E+00
I-131	4E-01	4E-01
Be-7	4E+00	2E+00
Ru-103	4E-01	4E-01
Ba-140	2E+00	2E+00
Cs-134	4E-01	4E-01
Ru-106	4E+00	2E+00
Cs-137	4E-01	4E-01
Zr-95	6E-01	6E-01
Nb-95	4E-01	4E-01
Co-58	4E-01	4E-01
Mn-54	4E-01	4E-01
Ag-110m	6E-01	4E-01
Ac-228	1E+00	1E+00
Fe-59	1E+00	8E-01
Zn-65	8E-01	6E-01
Co-60	6E-01	4E-01
K-40	1E+01	4E+00
La-140	1E+00	6E-01

NA - Not applicable. Sea water contains relatively high levels of natural radioactivity from K-40 and large amounts of dissolved salts which would interfere with these determinations.

8.4.9 Milk

Collection

A 4 L sample of milk is collected for gamma spectrometric analysis and if necessary preserved by addition of 15 mL of formaldehyde solution (37%). Distillate from an aliquot of the same sample, before addition of preservative, is used for tritium analysis.

Analysis and Detection Limits

For tritium analysis by liquid scintillation techniques, a 6 mL sample of distillate is mixed with 15 mL of Aquasol-II and counted for 100 minutes. For gamma spectrometric analysis, a 3.6 L sample is analyzed for 50 000 s (overnight) on a 24% efficient intrinsic germanium detector. Typical LLDs for the nuclides of interest in milk are listed below.

TABLE 8.05

LLD IN MILK

Nuclide	LLD (Bq/L)
H-3	4E+01
Ce-144	1E+00
Ce-141	2E-01
Cr-51	1E+00
I-131	1E-01
Be-7	1E+00
Ru-103	1E-01
Ba-140	8E-01
Cs-134	1E-01
Ru-106	1E+00
Cs-137	2E-01
Zr-95	2E-01
Nb-95	2E-01
Co-58	2E-01
Mn-54	2E-01
Ag-110m	1E-01
Ac-228	6E-01
Fe-59	4E-01
Zn-65	4E-01
Co-60	2E+00
K-40	2E+00
La-140	2E-01

8.4.10 Seafood

Collection and Preparation

Approximately 0.5 to 2 kg of fresh seafood is collected for analysis as available. The crabs and lobsters are cooked before analysis to facilitate removal of the meat. Whole, uncooked periwinkles and clams are analysed, but the analysis is attributed only to the flesh weight of the sample (about 25% of the total). In previous years only the edible fraction of these species was analyzed as for crabs and lobsters. Dulse, (Rhodymenia palmata) is the most commonly harvested edible seaweed in the Point Lepreau area. Irish Moss, (Chondrus crispus), which is commercially important (for example, in the food industry) is collected in other areas of the Bay of Fundy, i.e., St. Mary's Bay, but is not harvested in the Point Lepreau area. Other species of seaweed, e.g., Laminaria and Ascophylum have been examined for their commercial possibilities, but they are not currently harvested.

Analysis and Detection Limits

Approximately 0.25 kg of each prepared sample is counted for 5000 s on a 24% efficient gamma spectrometer. Typical LLDs are given below.

TABLE 8.06

LLD IN SEAFOOD (EDIBLE FRACTION)

Nuclide	LLD (Bq/kg)
Ce-144	1E+01
Ce-141	4E+00
Cr-51	1E+01
I-131	2E+00
Be-7	2E+01
Ru-103	4E+00
Ba-140	4E+00
Cs-134	2E+00
Ru-106	1E+01
Cs-137	2E+00
Zr-95	2E+00
Nb-95	2E+00
Co-58	2E+00
Mn-54	2E+00
Ag-110m	2E+00
Ac-228	8E+00
Fe-59	4E+00
Zn-65	4E+00
Co-60	2E+00
K-40	2E+01
La-140	2E+00

8.4.11 Vegetation

Collection and Preparation

The only vegetation types routinely collected and analyzed are tree lichen (Spanish moss) and various ground mosses such as Cladonia and Lycopodium. About 100 g or more of each of the samples is collected and air dried before analysis. No special preparation is required. Reference samples are collected from the Fredericton area.

Analysis and Detection Limits

Samples are analyzed for 5000 s on a 24% efficient gamma detector. Typical LLDs for a 100 g sample of lichen are given below.

TABLE 8.07

LLD IN VEGETATION

Nuclide	LLD (Bq/kg)
Ce-144	4E+01
Ce-141	1E+01
Cr-51	5E+01
I-131	9E+00
Be-7	5E+01
Ru-103	7E+00
Ba-140	3E+01
Cs-134	2E+01
Ru-106	6E+01
Cs-137	7E+00
Zr-95	8E+00
Nb-95	1E+01
Co-58	6E+00
Mn-54	4E+00
Ag-110m	8E+00
Ac-228	2E+01
Fe-59	8E+00
Zn-65	1E+01
Co-60	6E+00
K-40	4E+01
La-140	2E+01

9.0 ENVIRONMENTAL REPORTS OF PREVIOUS YEARS

PRE-OPERATIONAL (1975 - 1981)

1 Pre-Operational Radiological Environmental Monitoring Program for Point Lepreau Nuclear Generating Station. NBEPC-HP-75-1. J.A. Flanigan. 1975.

2 Pre-Operational Environmental Radiation Monitoring Data for Point Lepreau Generating Station. October 1, 1976 to June 30, 1979. NBEPC-HP-79-1. J.A. Flanigan and J.J. Paciga. Sept. 1979.

3 Pre-Operational Environmental Radiation Monitoring Data for Point Lepreau Generating Station. January 1, 1979 to December 31, 1979. NBEPC-HP-80-1. J.A. Flanigan. Sept. 1980.

4 Pre-Operational Environmental Radiation Monitoring Data for Point Lepreau Generating Station. January 1, 1980 to December 31, 1980. NBEPC-HP-81-1. J.K. Sutherland and J.A. Flanigan. July 1981.

5 Pre-Operational Environmental Radiation Monitoring Data for Point Lepreau Generating Station. January 1, 1981 to December 31, 1981. NBEPC-HP-82-1. J.K. Sutherland. February 1982.

OPERATIONAL (1982 -1990)

6 Operational Environmental Radiation Monitoring Program. Revision 1, January 1982. RD-01364-L15. J.K. Sutherland. Revision 2, June 1983. Revision 3, September 1985. Revision 4, February 1989.

7 Environmental Radiation Monitoring Data for Point Lepreau Generating Station. January 01, 1982 to December 31, 1982. HP-07000-83-1. J.K. Sutherland. March 1983.

8 Environmental Radiation Monitoring Data for Point Lepreau Generating Station. January 01, 1983 to December 31, 1983. HP-07000-84-1. J.K. Sutherland. February 1984.

9 Environmental Radiation Monitoring Data for Point Lepreau Generating Station. January 01, 1984 to December 31, 1984. HP-07000-85-1. J.K. Sutherland. February 1985.

10 Environmental Radiation Monitoring Data for Point Lepreau Generating Station. January 01, 1985 to December 31, 1985. HP-07000-86-1. J.K. Sutherland. March 1986.

11 Environmental Radiation Monitoring Data for Point Lepreau Generating Station. January 01, 1986 to December 31, 1986. HP-07000-87-1. J.K. Sutherland. February 1987.

12 Environmental Radiation Monitoring Data for Point Lepreau Generating Station. January 01, 1987 to December 31, 1987. HP-07000-88-1. J.K. Sutherland. February 1988.

13 Environmental Radiation Monitoring Data for Point Lepreau Generating Station. January 01, 1988 to December 31, 1988. HP-07000-89-1. J.K. Sutherland. February 1989.

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